DB2 11 for z/OS

Utility Guide and Reference

SC19-4067-06

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Note
Before using this information and the product it supports, be sure to read the general information under "Notices" at the end of this information.

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This edition applies to DB2 11 for z/OS (product number 5615-DB2), DB2 11 for z/OS Value Unit Edition (product number 5697-P43), DB2 Utilities Suite for z/OS, Version 11 (product number 5655-W87), and to any subsequent releases until otherwise indicated in new editions. Make sure you are using the correct edition for the level of the product.

Specific changes are indicated by a vertical bar to the left of a change. A vertical bar to the left of a figure caption indicates that the figure has changed. Editorial changes that have no technical significance are not noted.

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Contents

About this information xv
Who should read this information xv
DB2 Utilities Suite xv
Terminology and citations xvi
Accessibility features for DB2 11 for z/OS xvi
How to send your comments xvii
Naming conventions used in this information xvii
How to read syntax diagrams xx

Part 1. Basic information about the DB2 utilities 1

Chapter 1. Types of DB2 utilities 3

Chapter 2. DB2 utilities packaging 5
SMP/E jobs for DB2 utility products 5
Operation of DB2 utilities in a mixed-release data sharing environment. 6

Chapter 3. Privileges and authorization IDs for DB2 utilities 7

Chapter 4. Utilities that can be run on declared temporary objects 9

Chapter 5. Effect of utilities on objects that have the DEFINE NO attribute 11

Chapter 6. Effect of utilities on data that is encrypted through built-in functions 13

Part 2. DB2 online utilities 15

Chapter 7. Invoking DB2 online utilities. 17
Data sets that online utilities use 18
Utility control statements 22
Utility concurrency and compatibility. 27
Invoking an online utility by using the DB2 Utilities panel in DB2I 29
Invoking a DB2 utility by using the DSNU CLIST command in TSO 34
DSNU CLIST command syntax 36
DSNU CLIST command output. 40
The supplied JCL procedure (DSNUPROC) for invoking a DB2 online utility 41
Invoking a DB2 online utility by creating the JCL data set yourself 44

Chapter 8. Monitoring and controlling online utilities 47
Monitoring utilities 47
Monitoring processor use by utilities 48
Subsystem parameters for refining DFSMSdss COPY operation with utilities 48
Determining why a utility failed to complete 50
Terminating an online utility 51
Restarting an online utility 52
Overriding the default utility restart behavior by using the RESTART parameter 56
Restarting a utility after the output data set is full 57
How utilities restart with templates 57
How utilities restart with lists 58

Chapter 9. BACKUP SYSTEM 59
Syntax and options of the BACKUP SYSTEM control statement 60

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Before running BACKUP SYSTEM . . . 63
Copy pools . . . 63
Data sets that BACKUP SYSTEM uses . . . 64
Concurrency and compatibility for BACKUP SYSTEM . . . 64
Dumping a fast replication copy to tape . . . 65
Backups of log copy pools . . . 65
Termination or restart of BACKUP SYSTEM . . . 66
Sample BACKUP SYSTEM control statements . . . 66

Chapter 10. CATENFM . . . 69
Syntax and options of the CATENFM control statement . . . 69
Before converting the catalog . . . 70
Data sets that CATENFM uses when converting the catalog . . . 70
Concurrency and compatibility for CATENFM. . . . 71
Converting to new-function mode . . . 71
Termination or halt of CATENFM . . . 72

Chapter 11. CATMAINT . . . 73
Syntax and options of the CATMAINT control statement . . . 73
Before running CATMAINT . . . 76
Data sets that CATMAINT uses . . . 76
Concurrency and compatibility for CATMAINT . . . 76
Updating the catalog for a new release . . . 76
Renaming the owner, creator, and schema of database objects . . . 76
Changing the ownership of objects from an authorization ID to a role . . . 77
Changing the catalog name used by storage groups or index spaces and table spaces. . . . 77
Identifying invalidated packages after the owner, creator, or schema name of an object is renamed . . . 78
Termination or restart of CATMAINT. . . . 78

Chapter 12. CHECK DATA . . . 79
Syntax and options of the CHECK DATA control statement . . . 80
Before running CHECK DATA . . . 91
Data sets that CHECK DATA uses . . . 92
Concurrency and compatibility for CHECK DATA . . . 96
Exception tables for the CHECK DATA utility . . . 98
Exception processing for tables with auxiliary columns . . . 99
Specifying the scope of CHECK DATA . . . 99
How violations are identified . . . 100
Detection and correction of constraint violations. . . . 100
CHECK DATA XML error detection . . . 101
Correcting XML data after running CHECK DATA . . . 101
Resetting CHECK-pending status. . . . 102
LOB column errors . . . 102
Resetting auxiliary CHECK-pending status . . . 104
Termination and restart of CHECK DATA . . . 104
Sample CHECK DATA control statements . . . 104

Chapter 13. CHECK INDEX. . . . 109
Syntax and options of the CHECK INDEX control statement . . . 110
Data sets that CHECK INDEX uses . . . 114
Shadow data sets . . . 115
Concurrency and compatibility for CHECK INDEX. . . . 117
Single logical partitions . . . 119
Indexes in parallel. . . . 119
Reviewing CHECK INDEX output . . . 123
Termination or restart of CHECK INDEX . . . 124
Correcting XML data after running CHECK INDEX . . . 124
Sample CHECK INDEX control statements . . . 124

Chapter 14. CHECK LOB 127
Syntax and options of the CHECK LOB control statement 128
Before running CHECK LOB 131
Data sets that CHECK LOB uses 131
Concurrency and compatibility for CHECK LOB 134
How CHECK LOB identifies violations 135
Removing CHECK-pending status for a LOB table space 135
Resolving media failure 135
Termination or restart of CHECK LOB 136
Sample CHECK LOB control statements 136

Chapter 15. COPY 139
Syntax and options of the COPY control statement 141
Before running COPY 153
Data sets that COPY uses 153
Concurrency and compatibility for COPY 156
Full image copies 159
Incremental image copies 160
Multiple image copies 161
FlashCopy image copies 163
Copies of lists of objects 167
Using more than one COPY statement 169
Copying partitions or data sets simultaneously 169
Copies of partition-by-growth table spaces 170
Copies of XML table spaces 170
Copying catalog and directory objects 170
Make copies of XML schema repository objects 171
Copies of Indexes 171
Using DFSMSdss concurrent copy 172
Specifying conditional image copies 174
| Allocation of sequential image copy data sets 175
Preparing for recovery by using the COPY utility 175
Improving performance 176
Generation data group definitions for the COPY utility 177
Using DB2 with DFSMS products 177
Image copies on tape 177
Termination of COPY 177
Restart of COPY 178
Sample COPY control statements 179

Chapter 16. COPYTOCOPY 191
Syntax and options of the COPYTOCOPY control statement 192
Data sets that COPYTOCOPY uses 197
Concurrency and compatibility for COPYTOCOPY 199
Full or incremental image copies with COPYTOCOPY 200
Incremental image copies with COPYTOCOPY 200
Using more than one COPYTOCOPY statement 201
Copying from a specific image copy 201
Copying a FlashCopy image copy by using COPYTOCOPY 201
Using TEMPLATE with COPYTOCOPY 202
Updating SYSCOPY records 202
How COPYTOCOPY determines which input copy to use 202
Generation data group definitions for the COPYTOCOPY utility 203
Using DB2 with DFSMS products 203
Image copies on tape 203
Copies of lists of objects from tape 203
Termination or restart of COPYTOCOPY 204
Sample COPYTOCOPY control statements 205

Chapter 17. DIAGNOSE 209
Syntax and options of the DIAGNOSE control statement 209
Data sets that DIAGNOSE uses 213
Concurrency and compatibility for DIAGNOSE 213
How to force a utility abend 214
Termination or restart of DIAGNOSE 214
Sample DIAGNOSE control statements 214

Chapter 18. EXEC SQL 217
Syntax and options of the EXEC SQL control statement 217
Concurrency and compatibility for EXEC SQL 219
Termination or restart of EXEC SQL 219
Sample EXEC SQL control statements 219

Chapter 19. LISTDEF 221
Syntax and options of the LISTDEF control statement 221
Concurrency and compatibility for LISTDEF 231
Creating the LISTDEF control statement 232
How to include objects in a list 232
Previewing the contents of a list 236
Creating LISTDEF libraries 236
Referencing LISTDEF lists in other utility jobs 237
Using the TEMPLATE utility with LISTDEF 239
Using the OPTIONS utility with LISTDEF 239
Termination or restart of LISTDEF 240
Sample LISTDEF control statements 240

Chapter 20. LOAD 245
Syntax and options of the LOAD control statement 247
Before running LOAD 303
Data sets that LOAD uses 304
Concurrency and compatibility for LOAD 309
Preparing DB2 internal format input records that are not generated by UNLOAD for LOAD 312
When to use SORTKEYS NO 312
Loading variable-length data 313
How LOAD orders loaded records 313
Replacing data with LOAD 313
Loading tables with special column types by using generated LOAD statements 316
Adding more data to a table or partition 318
Deleting all the data in a table space 318
Loading partitions 319
Partition-by-growth table spaces 322
Loading data containing XML columns 322
Loading delimited files 323
Loading data with referential constraints 326
Referential constraint violations 327
Compressing data by using the LOAD utility 328
How to load data from DL/I 330
Loading data by using the cross-loader function 331
How to use inline COPY with LOAD 332
Creating a FlashCopy image copy with LOAD 333
Improving LOAD performance 334
Conversion of input data 338
Specifying input fields 339
Specifying the TRUNCATE and STRIP options 340
How LOAD builds indexes while loading data 340
Building indexes in parallel for LOAD 341
How LOAD leaves free space 343
Loading with RECOVER-pending, REBUILD-pending, or REORG-pending status 344
Exit procedures 344

Loading ROWID columns . . . 345
Loading a LOB column . . . 345
LOAD LOG on a LOB table space . . . 346
Loading an XML column . . . 347
LOAD LOG on an XML table space . . . 348
Running LOAD RESUME YES SHRLEVEL CHANGE without logging . . . 348
Collecting inline statistics while loading a table . . . 349
Inline COPY for a base table space . . . 350
Termination of LOAD . . . 350
Restart of LOAD . . . 350
After running LOAD . . . 352
Copying the loaded table space or partition . . . 353
Resetting restricted status after running the LOAD utility . . . 353
Running CHECK INDEX after loading a table that has indexes . . . 357
Recovering data after a failed LOAD job . . . 357
Reorganization of an auxiliary index after LOAD . . . 358
Effects of running LOAD . . . 358
Sample LOAD control statements . . . 359

Chapter 21. MERGECOPY . . . 373
Syntax and options of the MERGECOPY control statement . . . 374
Data sets that MERGECOPY uses . . . 377
Concurrency and compatibility for MERGECOPY . . . 378
Full or incremental image copy . . . 379
How MERGECOPY determines which input copy to use . . . 379
Merging online copies . . . 379
Using MERGECOPY with individual data sets . . . 380
Using MERGECOPY or COPY . . . 380
Avoiding MERGECOPY LOG RBA inconsistencies . . . 380
Termination or restart of MERGECOPY . . . 381
Sample MERGECOPY control statements . . . 381

Chapter 22. MODIFY RECOVERY . . . 385
Syntax and options of the MODIFY RECOVERY control statement . . . 387
Before running MODIFY RECOVERY . . . 390
Data sets that MODIFY RECOVERY uses . . . 390
Concurrency and compatibility for MODIFY RECOVERY . . . 391
How MODIFY RECOVERY deletes rows . . . 391
Reclaiming space in the DBD . . . 393
Improving REORG performance after adding a column . . . 393
Termination or restart of MODIFY RECOVERY . . . 394
The effect of MODIFY RECOVERY on version numbers . . . 394
Sample MODIFY RECOVERY control statements . . . 395

Chapter 23. MODIFY STATISTICS . . . 399
Syntax and options of the MODIFY STATISTICS control statement . . . 400
Data sets that MODIFY STATISTICS uses . . . 402
Concurrency and compatibility for MODIFY STATISTICS . . . 402
Guidelines for deciding which statistics history rows to delete . . . 403
Deletion of specific statistics history rows . . . 403
Termination or restart of MODIFY STATISTICS . . . 403
Sample MODIFY STATISTICS control statements . . . 404

Chapter 24. OPTIONS . . . 407
Syntax and options of the OPTIONS control statement . . . 407
Concurrency and compatibility for OPTIONS . . . 410
Executing statements in preview mode . . . 411
Specifying LISTDEF and TEMPLATE libraries . . . 411
Overriding standard utility processing behavior . . . 411
Termination or restart of OPTIONS . . . 412

Sample OPTIONS control statements 412

Chapter 25. QUIESCE 415
Syntax and options of the QUIESCE control statement 416
Before running QUIESCE 419
Data sets that QUIESCE uses 419
Concurrency and compatibility for QUIESCE 419
Use of QUIESCE on catalog and directory objects 421
Common quiesce points 421
Running QUIESCE on a table space in pending status 422
Reasons why QUIESCE fails to write to disk 423
Termination and restart of QUIESCE 423
Sample QUIESCE control statements 423

Chapter 26. REBUILD INDEX 427
Syntax and options of the REBUILD INDEX control statement 428
Before running REBUILD INDEX 440
Data sets that REBUILD INDEX uses 440
Concurrency and compatibility for REBUILD INDEX 442
Access with REBUILD INDEX SHRLEVEL 444
Rebuilding index partitions 445
Rebuilding indexes on partition-by-growth table spaces 446
How to improve performance when rebuilding index partitions 446
Rebuilding multiple indexes 447
Resetting the REBUILD-pending status 451
Rebuilding critical catalog indexes 452
Recoverability of a rebuilt index 452
Creating a FlashCopy image copy with REBUILD INDEX 452
Termination or restart of REBUILD INDEX 453
The effect of REBUILD INDEX on index version numbers 453
Sample REBUILD INDEX control statements 454

Chapter 27. RECOVER 457
Syntax and options of the RECOVER control statement 460
Before running RECOVER 471
Data sets that RECOVER uses 472
Concurrency and compatibility for RECOVER 472
Recovering with a system-level backup 474
How to determine which system-level backups DB2 recovers 475
Determining which recovery base DB2 uses 476
Determining whether the system-level backups reside on disk or tape 476
Recovering a table space 477
Recovering a list of objects 478
Recovering a data set or partition 479
Recovering with incremental copies 479
Recovering with FlashCopy image copies 480
Recovering a page 481
Recovering an error range 482
Effect on RECOVER of the NOT LOGGED or LOGGED table space attributes 483
Recovering with a data set copy that is not made by DB2 483
Recovering catalog and directory objects 484
Objects that contain recovery information 489
Point-in-time recovery of the catalog, directory, and all user objects 491
Reinitializing DSNDB01.SYSUTILX 492
Recovering a table space that contains LOB or XML data 493
Recovering a table space that contains clone objects 494
Point-in-time recovery 494
Avoiding specific image copy data sets during a recovery 502
How to improve RECOVER performance 502
Optimizing the LOGAPPLY phase 503

Recovering image copies in a JES3 environment . . . 505
Resetting RECOVER-pending or REBUILD-pending status . . . 505
How the RECOVER utility allocates incremental image copies . . . 506
How the RECOVER utility performs fallback recovery. . . . 506
How the RECOVER utility retains tape mounts . . . 507
Avoiding damaged media . . . 507
Termination or restart of RECOVER . . . 507
Effects of running RECOVER . . . 508
Sample RECOVER control statements . . . 509

Chapter 28. REORG INDEX . . . 513
Syntax and options of the REORG INDEX control statement . . . 514
Before running REORG INDEX . . . 531
Data sets that REORG INDEX uses . . . 533
Concurrency and compatibility for REORG INDEX . . . 537
Determining which indexes require reorganization . . . 539
Using the LEAFDISTLIMIT and REPORTONLY options to determine when reorganization is needed . . . 540
Access with REORG INDEX SHRLEVEL . . . 540
Creating a FlashCopy image copy with REORG INDEX . . . 542
Temporarily interrupting REORG. . . . 543
Improving performance with REORG INDEX . . . 543
Termination of REORG INDEX . . . 544
Restart of REORG INDEX . . . 545
Review of REORG INDEX output . . . 546
Effect of REORG INDEX on index version numbers . . . 547
Sample REORG INDEX control statements . . . 547

Chapter 29. REORG TABLESPACE . . . 551
Syntax and options of the REORG TABLESPACE control statement . . . 555
Before running REORG TABLESPACE . . . 599
Data sets that REORG TABLESPACE uses . . . 604
Concurrency and compatibility for REORG TABLESPACE . . . 612
Determining whether an object requires reorganization . . . 617
Access with REORG TABLESPACE SHRLEVEL . . . 619
Unloading without reloading . . . 622
Reclaiming space from dropped tables . . . 622
Reorganizing the catalog and directory . . . 623
Changing data set definitions . . . 626
Temporarily interrupting REORG. . . . 627
How to override dynamic sort work data set allocation . . . 627
Redistributing data across partitions by using REORG. . . . 628
How partitions can be unloaded and reloaded in parallel. . . . 629
How to use inline copy with REORG TABLESPACE . . . 629
Creating a FlashCopy image copy with REORG TABLESPACE . . . 630
Improving REORG TABLESPACE performance . . . 631
Parallel index building for REORG TABLESPACE . . . 633
How DB2 unloads data . . . 637
Failure during the RELOAD phase . . . 637
Reorganization of partitioned table spaces . . . 637
Reorganization of partition-by-growth table spaces . . . 637
Reorganization of segmented table spaces . . . 638
Comparison of the numbers of loaded and unloaded records . . . 639
Reorganization of a LOB table space. . . . 639
Reorganization of an XML table space . . . 640
| Reorganization with pending definition changes. . . . 641
| Compression after materialization of inline LOB changes . . . 642
Termination of REORG TABLESPACE . . . 642
Restart of REORG TABLESPACE . . . 644
Review of REORG TABLESPACE output . . . 646
After running REORG TABLESPACE . . . 647

Effects of running REORG TABLESPACE . . . 647
Sample REORG TABLESPACE control statements . . . 649

Chapter 30. REPAIR. . . . 663
Syntax and options of the REPAIR control statement . . . 664
Before running REPAIR . . . 681
Data sets that REPAIR uses . . . 681
Concurrency and compatibility for REPAIR . . . 682
Resetting table space status . . . 685
Resetting index space status . . . 685
Repairing a damaged page . . . 686
Repairing DBDs . . . 686
Locating rows by key . . . 687
Using VERIFY with REPLACE and DELETE operations . . . 688
Repairing critical catalog table spaces and indexes . . . 688
Termination or restart of REPAIR . . . 688
Review of REPAIR output . . . 688
After running REPAIR . . . 689
Sample REPAIR control statements . . . 689

Chapter 31. REPORT . . . 693
Syntax and options of the REPORT control statement . . . 695
Data sets that REPORT uses . . . 699
Concurrency and compatibility for REPORT . . . 699
Running REPORT on the catalog and directory . . . 700
Termination or restart of REPORT . . . 700
REPORT output . . . 700
Sample REPORT control statements . . . 710

Chapter 32. RESTORE SYSTEM . . . 727
Syntax and options of the RESTORE SYSTEM control statement . . . 728
Before running RESTORE SYSTEM . . . 730
Data sets that RESTORE SYSTEM uses . . . 732
Concurrency and compatibility for RESTORE SYSTEM . . . 733
Restoring data in a data sharing environment . . . 733
Using DISPLAY UTILITY with RESTORE SYSTEM . . . 733
Termination and restart of RESTORE SYSTEM . . . 733
Effects of running RESTORE SYSTEM . . . 734
After running RESTORE SYSTEM . . . 734
Sample RESTORE SYSTEM control statements . . . 735

Chapter 33. RUNSTATS . . . 737
Syntax and options of the RUNSTATS control statement . . . 739
The statistics profile syntax . . . 758
Before running RUNSTATS . . . 761
Data sets that RUNSTATS uses . . . 762
Concurrency and compatibility for RUNSTATS . . . 764
Collecting distribution statistics for column groups . . . 766
Updating statistics for a partitioned table space . . . 766
Collection of statistics on the DB2 catalog and directory . . . 767
Collecting frequency statistics for data-partitioned secondary indexes . . . 767
Collecting statistics history . . . 768
Collection of statistics on LOB table spaces . . . 768
Collection of statistics on XML objects . . . 768
Termination or restart of RUNSTATS . . . 770
Review of RUNSTATS output . . . 770
Resetting access path statistics . . . 774
After running RUNSTATS . . . 777
Sample RUNSTATS control statements . . . 777

Chapter 34. STOSPACE . . . 783
Syntax and options of the STOSPACE control statement . . . 784
Data sets that STOSPACE uses . . . 784
Concurrency and compatibility for STOSPACE . . . 785
How STOSPACE ensures availability of objects it STOSPACE requires . . . 785
Obtaining statistical information with STOSPACE . . . 785
Analysis of the values in a SPACE or SPACEF column . . . 786
Termination or restart of STOSPACE. . . . 787
Sample STOSPACE control statement . . . 787

Chapter 35. TEMPLATE . . . 789
Syntax and options of the TEMPLATE control statement . . . 789
Before running TEMPLATE. . . . 806
Concurrency and compatibility for TEMPLATE . . . 806
Key TEMPLATE operations . . . 806
Choosing data set names . . . 807
Default space calculations for data set templates. . . . 808
Guidelines for templates and tape data sets . . . 809
How TEMPLATE supports GDG data sets. . . . 810
Template switching . . . 811
Termination or restart of TEMPLATE . . . 811
Sample TEMPLATE control statements . . . 811

Chapter 36. UNLOAD . . . 817
Syntax and options of the UNLOAD control statement . . . 818
Before running UNLOAD . . . 857
Data sets that UNLOAD uses . . . 857
Concurrency and compatibility for UNLOAD . . . 858
Unloading partitions . . . 860
Unloading XML data . . . 861
Unloading LOB data . . . 862
Unloading data in spanned record format . . . 862
Selecting tables and rows to unload . . . 864
Selecting and ordering columns to unload . . . 864
Unloading data from image copy data sets . . . 864
Data conversion with the UNLOAD utility . . . 866
Output field types. . . . 867
Output field positioning and size. . . . 869
Layout of output fields . . . 870
Output for special values Infinity, sNaN, or NaN . . . 872
Unloading delimited files . . . 873
Specifying TRUNCATE and STRIP options for output data . . . 875
LOAD statements that are generated by UNLOAD . . . 876
Unloading compressed data . . . 877
Field specification errors. . . . 877
Termination or restart of UNLOAD . . . 877
Sample UNLOAD control statements . . . 878

Part 3. DB2 stand-alone utilities . . . 885

Chapter 37. Invoking stand-alone utilities . . . 887
Specifying options for stand-alone utilities by using the JCL EXEC PARM parameter . . . 888
Stand-alone utility control statements . . . 889

Chapter 38. DSNJCNVB 891

Chapter 39. DSNJCNVT 893

Chapter 40. DSNJLOGF (preformat active log) 895

Chapter 41. DSNJU003 (change log inventory) 897
Syntax and options of the DSNJU003 control statement 898
Making changes for active logs 913
Making changes for archive logs 914
A conditional restart control record 915
Deleting log data sets with errors. 915
Altering references to log data sets in the BSDS 917
Defining the high-level qualifier for catalog and directory objects 917
Renaming DB2 system data sets 918
Renaming DB2 active log data sets 918
Renaming DB2 archive log data sets. 919
Sample DSNJU003 control statements 919

Chapter 42. DSNJU004 (print log map) 923
Syntax and options of the DSNJU004 control statement 925
Sample DSNJU004 control statement 925
DSNJU004 (print log map) output 926

Chapter 43. DSN1COMP 941
Syntax and options of the DSN1COMP control statement. 943
Before running DSN1COMP 946
How to estimate compression savings achieved with option REORG 947
Free space in compression calculations on table space 947
Sample DSN1COMP control statements 948
DSN1COMP output 950

Chapter 44. DSN1COPY 953
Syntax and options of the DSN1COPY control statement 956
Before running DSN1COPY 961
Data sets that DSN1COPY uses 963
Inconsistent data checks 968
The effects of not specifying the OBIDXLAT option. 968
Requirements for using an image copy as input to DSN1COPY. 969
Copying from an image copy 969
Restoring indexes with DSN1COPY 970
Restoring table spaces with DSN1COPY 970
Printing with DSN1COPY 972
Copying tables from one subsystem to another 972
Sample DSN1COPY control statements 974

Chapter 45. DSN1LOGP 979
Syntax and options of the DSN1LOGP control statement 981
Determining the PSID for base and clone objects 989
Archive log data sets on tape 989
Sample DSN1LOGP control statements 990
DSN1LOGP output 993

Chapter 46. DSN1PRNT 999
Syntax and options of the DSN1PRNT control statement 1000
Printing with DSN1PRNT instead of DSN1COPY 1006
Determining the page size and data set size for DSN1PRNT 1006
Sample DSN1PRNT control statements 1007

Chapter 47. DSN1SDMP 1011
Syntax and options of the DSN1SDMP control statement 1012
Assigning buffers. 1017
Conditions for generating a dump 1018
Stopping or modifying DSN1SDMP traces 1018
Sample DSN1SDMP control statements 1019

Part 4. Appendixes 1023

Appendix A. Limits in DB2 for z/OS 1025

Appendix B. DB2-supplied stored procedures for utility operations 1033
DSNUTILS stored procedure (deprecated) 1033
DSNUTILU stored procedure. 1044
DSNACCOR stored procedure (deprecated) 1048
DSNACCOX stored procedure 1069

Appendix C. Advisory or restrictive states 1103
Auxiliary CHECK-pending status 1103
Auxiliary warning status 1104
CHECK-pending status. 1105
COPY-pending status 1106
DBETE status 1107
Group buffer pool RECOVER-pending status 1108
Informational COPY-pending status 1108
PRO restricted status 1108
REBUILD-pending status 1109
RECOVER-pending status 1110
REFRESH-pending status 1111
REORG-pending status 1111
Restart-pending status 1114

Appendix D. Productivity-aid sample programs 1117
DSNTIAUL. 1118
DSNTIAD 1124
DSNTEP2 and DSNTEP4 1125

Appendix E. DSN1SMFP 1133
Before running DSN1SMFP 1134
Running DSN1SMFP 1135
Sample DSN1SMFP control statement 1135
DSN1SMFP output 1136
DSN1SMFP output record structure 1137
Standard report header 1137
IFCID003: DDF Location 1139
IFCID004: Trace Start 1140
IFCID005: Trace Stop 1140
IFCID023: Utility Start 1141
IFCID024: Utility Change 1144
IFCID025: Utility End 1145
IFCID083: Identify End 1146
IFCID106: System Parameters (security-relevant fields only) 1147
IFCID140: Audit Authorization Failures 1156
IFCID141: Audit DDL Grant/Revoke 1162
IFCID142: Audit DDL Create/Alter/Drop 1163
IFCID143: Audit First Write 1165
IFCID144: Audit First Read 1166
IFCID145: Audit DML Statement 1166
IFCID269: Trusted Connection 1168

IFCID270: Trusted Context . . . 1170
IFCID350: SQL Statement . . . 1170
IFCID361: Audit Administrative Authorities . . . 1172
IFCID362: Trace Start and Stop with AUDITPOLICY . . . 1176
SYSPRINT: Runtime messages and end-of-job summary . . . 1178

Appendix F. DSNADMSB . . . 1179
Parameters of the DSNADMSB program . . . 1180
Before running DSNADMSB . . . 1187
Data sets that DSNADMSB uses . . . 1187
Copying the data that DSNADMSB and ADMIN_INFO_SQL collect to another subsystem . . . 1188
Examples of DSNADMSB invocation . . . 1189

Appendix G. DSNTSMFD . . . 1197
Before running DSNTSMFD . . . 1197
Data sets that DSNTSMFD uses . . . 1198
Examples of DSNTSMFD invocation . . . 1198

Appendix H. How real-time statistics are used by DB2 utilities . . . 1201

Appendix I. Delimited file format . . . 1203
Data types in delimited files . . . 1204
Examples of delimited files . . . 1205

Information resources for DB2 for z/OS and related products . . . 1207

Notices . . . 1209
Programming interface information . . . 1210
Trademarks . . . 1211
Privacy policy considerations . . . 1212

Glossary . . . 1213

Index . . . 1215

About this information

This information contains usage information for the tasks of system administration, database administration, and operation. It presents detailed information about using utilities, specifying syntax (including keyword and parameter descriptions), and starting, stopping, and restarting utilities. This book also includes job control language (JCL) and control statements for each utility.

This information about DB2® assumes that your DB2 subsystem is running in Version 11 new-function mode, and that your application is running with the application compatibility value of 'V11R1'. Generally, new SQL capability that is described, including changes to existing language elements, functions, data manipulation statements, and limits, is available only in new-function mode with applications set to an application compatibility value of 'V11R1'.

The behavior of data definition statements such as CREATE, ALTER, and DROP, which embed a data manipulation SQL statement that contains new capability, is dependent on the application compatibility value that is in effect for the application. An application compatibility value of 'V11R1' must be in effect for applications to use new capability in embedded statements such as SELECT, INSERT, UPDATE, DELETE, MERGE, CALL, and SET*assignment-statement*. Otherwise, an application compatibility value of 'V10R1' can be used for data definition statements.

SQL statements that run in Version 10 new-function mode can continue to run in Version 11 in conversion mode or in new-function mode with an application compatibility value of 'V10R1', with the same expected behavior as in Version 10.

Optimization and virtual storage enhancements are available in conversion mode unless stated otherwise.

Who should read this information

This information is intended for system administrators, database administrators, system operators, and application programmers of DB2 online and stand-alone utilities.

Recommendation: Familiarize yourself with DB2 for z/OS® prior to using this book.

DB2 Utilities Suite

Important: In this version of DB2 for z/OS, the DB2 Utilities Suite is available as an optional product. You must separately order and purchase a license to such utilities, and discussion of those utility functions in this publication is not intended to otherwise imply that you have a license to them.

In Version 11, DB2 utilities can use the DFSORT program regardless of whether you purchased a license for DFSORT on your system. For more information, see the following informational APARs:

- II14047
- II14213

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- II13495

DB2 utilities can use IBM® DB2 Sort for z/OS (5655-W42) as an alternative to DFSORT for utility SORT and MERGE functions. Use of DB2 Sort for z/OS requires the purchase of a DB2 Sort license. For more information about DB2 Sort, see DB2 Sort for z/OS.

Related information

DB2 utilities packaging (Utility Guide)

Terminology and citations

When referring to a DB2 product other than DB2 for z/OS, this information uses the product's full name to avoid ambiguity.

The following terms are used as indicated:

DB2 Represents either the DB2 licensed program or a particular DB2 subsystem.

Tivoli® OMEGAMON® XE
Refers to any of the following products:
- IBM Tivoli OMEGAMON XE for DB2 Performance Expert on z/OS
- IBM Tivoli OMEGAMON XE for DB2 Performance Monitor on z/OS
- IBM DB2 Performance Expert for Multiplatforms and Workgroups
- IBM DB2 Buffer Pool Analyzer for z/OS

C, C++, and C language
Represent the C or C++ programming language.

CICS® Represents CICS Transaction Server for z/OS.

IMS™ Represents the IMS Database Manager or IMS Transaction Manager.

MVS™ Represents the MVS element of the z/OS operating system, which is equivalent to the Base Control Program (BCP) component of the z/OS operating system.

RACF®
Represents the functions that are provided by the RACF component of the z/OS Security Server.

Accessibility features for DB2 11 for z/OS

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use information technology products successfully.

Accessibility features

The following list includes the major accessibility features in z/OS products, including DB2 11 for z/OS. These features support:

- Keyboard-only operation.
- Interfaces that are commonly used by screen readers and screen magnifiers.
- Customization of display attributes such as color, contrast, and font size

Tip: The Information Management Software for z/OS Solutions Information Center (which includes information for DB2 11 for z/OS) and its related publications are accessibility-enabled for the IBM Home Page Reader. You can operate all features using the keyboard instead of the mouse.

Keyboard navigation

For information about navigating the DB2 11 for z/OS ISPF panels using TSO/E or ISPF, refer to the *z/OS TSO/E Primer*, the *z/OS TSO/E User's Guide*, and the *z/OS ISPF User's Guide*. These guides describe how to navigate each interface, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

Related accessibility information

IBM and accessibility

See the *IBM Accessibility Center* at http://www.ibm.com/able for more information about the commitment that IBM has to accessibility.

How to send your comments

Your feedback helps IBM to provide quality information. Please send any comments that you have about this book or other DB2 for z/OS documentation.

Send your comments by email to db2zinfo@us.ibm.com and include the name of the product, the version number of the product, and the number of the book. If you are commenting on specific text, please list the location of the text (for example, a chapter and section title or a help topic title).

Naming conventions used in this information

When you use DB2 commands and utilities, be aware of the applicable naming conventions

When you use a parameter for an object that is created by SQL statements (for example, tables, table spaces, and indexes), identify the object by following the SQL syntactical naming conventions.

In this information, characters are classified as *letters*, *digits*, or *special characters*.

- A *letter* is any one of the uppercase characters A through Z (including the three characters that are reserved in the United States as alphabetic extenders for national languages, #, @, and $.).
- A *digit* is any one of the characters 0 through 9.
- A *special character* is any character other than a letter or a digit.

authorization-id
: A short identifier of one to eight letters, digits, or the underscore that identifies a set of privileges. An authorization ID must begin with a letter.

connection-name
: An identifier of one to eight characters that identifies an address space connection to DB2. A connection identifier is one of the following values:
  - TSO (for DSN processes that run in TSO foreground).
  - BATCH (for DSN processes that run in TSO batch).
  - DB2CALL (for the call attachment facility (CAF)).
  - The system identification name (for IMS and CICS processes).

  Related information:

  Managing connection requests from local applications (Managing Security)

correlation-id
An identifier of 1 to 12 characters that identifies a process within an address space connection. A correlation ID must begin with a letter.

A correlation ID can be one of the following values:

- The TSO logon identifier (for DSN processes that run in TSO foreground and for CAF processes).
- The job name (for DSN processes that run in TSO batch).
- The PST#.PSBNAME (for IMS processes).
- The entry identifier.thread_number.transaction_identifier (for CICS processes).

cursor-name
An identifier that designates a result set. Cursor names that are specified with the EXEC SQL and LOAD utilities cannot be longer than eight characters.

database-name
A short identifier that identifies a database. The identifier must start with a letter and must not include special characters.

data-set-name
An identifier of 1 to 44 characters that identifies a data set.

dbrm-member-name
An identifier of one to eight letters or digits that identifies a member of a partitioned data set.

A DBRM member name should not begin with DSN because of a potential conflict with DB2-provided DBRM member names. If you specify a DBRM member name that begins with DSN, DB2 issues a warning message.

dbrm-pds-name
An identifier of 1 to 44 characters that identifies a partitioned data set.

ddname
An identifier of one to eight characters that identifies the name of a DD statement.

hexadecimal-constant
A sequence of digits or any of the letters from A to F (uppercase or lowercase).

hexadecimal-string
An X followed by a sequence of characters that begins and ends with the string delimiter, an apostrophe. The characters between the string delimiters must be a hexadecimal number.

index-name
A qualified or unqualified name that identifies an index.

A qualified index name is a schema name followed by a period and an identifier.

An unqualified index name is an identifier with an implicit schema name qualifier. The implicit schema is determined by the SQL rules for unqualified types, functions, procedures, global variables, and specific names.

If the index name contains a blank character, the name must be enclosed in quotation marks when specified in a utility control statement.

Related information:

Unqualified type, function, procedure, global variable, and specific names (DB2 SQL)

location-name
A location identifier of 1 to 16 letters (but excluding the alphabetic extenders), digits, or the underscore that identifies an instance of a database management system. A location name must begin with a letter.

luname
An SQL short identifier of one to eight characters that identifies a logical unit name. A LU name must begin with a letter.

member-name
An identifier of one to eight letters (including the three alphabetic extenders) or digits that identifies a member of a partitioned data set.

A member name should not begin with DSN because of a potential conflict with DB2-provided member names. If you specify a member name that begins with DSN, DB2 issues a warning message.

qualifier-name
An SQL short identifier of one to eight letters, digits, or the underscore that identifies the implicit qualifier for unqualified table names, views, indexes, and aliases.

string
A sequence of characters that begins and ends with an apostrophe.

subsystem-name
An identifier that specifies the DB2 subsystem as it is known to the operating system.

table-name
A qualified or unqualified name that designates a table.

A fully qualified table name is a three-part name. The first part is a location name that designates the DBMS at which the table is stored. The second part is a schema name. The third part is an SQL identifier. A period must separate each of the parts.

A two-part table name is implicitly qualified by the location name of the current server. The first part is a schema name. The second part is an SQL identifier. A period must separate the two parts.

A one-part or unqualified table name is an SQL identifier with two implicit qualifiers. The first implicit qualifier is the location name of the current server. The second is a schema name, which is determined by the SQL rules for unqualified types, functions, procedures, global variables, and specific names.

If the table name contains a blank, the name must be enclosed in quotation marks when specified in a utility control statement.

Related information:

Unqualified type, function, procedure, global variable, and specific names (DB2 SQL)

table-space-name
A short identifier that identifies a table space of an identified database. The identifier must start with a letter and must not include special characters. If a database is not identified, a table space name specifies a table space of database DSNDB04.

utility-id
An identifier of 1 to 16 characters that uniquely identifies a utility process

within DB2. A utility ID must begin with a letter. The remaining characters can be uppercase and lowercase letters, numbers 0 through 9, and the following characters: #, $, ., ¢, !, ¬, and @.

Related concepts:

Naming conventions (DB2 SQL)

SQL identifiers (DB2 SQL)

How to read syntax diagrams

Certain conventions apply to the syntax diagrams that are used in IBM documentation.

Apply the following rules when reading the syntax diagrams that are used in DB2 for z/OS documentation:

- Read the syntax diagrams from left to right, from top to bottom, following the path of the line.

  The ►►— symbol indicates the beginning of a statement.

  The —► symbol indicates that the statement syntax is continued on the next line.

  The ►— symbol indicates that a statement is continued from the previous line.

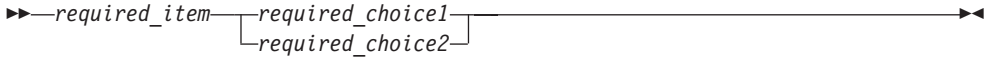
  The —►◄ symbol indicates the end of a statement.
- Required items appear on the horizontal line (the main path).

- Optional items appear below the main path.

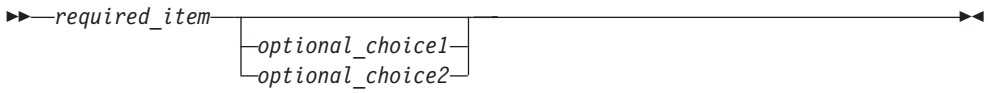
  If an optional item appears above the main path, that item has no effect on the execution of the statement and is used only for readability.

- If you can choose from two or more items, they appear vertically, in a stack.

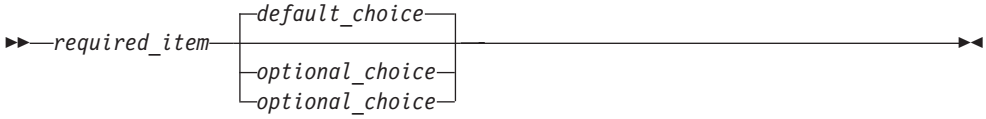
  If you *must* choose one of the items, one item of the stack appears on the main path.



  If choosing one of the items is optional, the entire stack appears below the main path.



If one of the items is the default, it appears above the main path and the remaining choices are shown below.

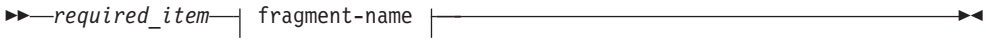


- An arrow returning to the left, above the main line, indicates an item that can be repeated.

If the repeat arrow contains a comma, you must separate repeated items with a comma.

A repeat arrow above a stack indicates that you can repeat the items in the stack.

- Sometimes a diagram must be split into fragments. The syntax fragment is shown separately from the main syntax diagram, but the contents of the fragment should be read as if they are on the main path of the diagram.



fragment-name:

- With the exception of XPath keywords, keywords appear in uppercase (for example, `FROM`). Keywords must be spelled exactly as shown. XPath keywords are defined as lowercase names, and must be spelled exactly as shown. Variables appear in all lowercase letters (for example, *column-name*). They represent user-supplied names or values.
- If punctuation marks, parentheses, arithmetic operators, or other such symbols are shown, you must enter them as part of the syntax.

Part 1. Basic information about the DB2 utilities

Use IBM DB2 utilities to help maintain data in your DB2 for z/OS databases.

Related concepts:

DB2 utilities (Introduction to DB2 for z/OS)

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Chapter 1. Types of DB2 utilities

IBM offers two types of DB2 utilities: online utilities and stand-alone utilities.

Most of the basic utilities, such as LOAD and COPY, are *online utilities*; they require DB2 to be up and running. DB2 online utilities run as standard batch jobs or stored procedures. They do not run under control of the terminal monitor program (TMP); they have their own attachment mechanism and they invoke DB2 control facility services directly.

The other type of utilities is *stand-alone utilities*. These utilities run independently of DB2. They work directly on the data sets. You can use stand-alone utilities to do tasks such as format logs, modify the bootstrap data set (BSDS), and copy and print data sets. The stand-alone utilities run as batch jobs. The only way to run these utilities is to use JCL.

Exception: Some DB2 for z/OS users use the term *online utilities* to mean something other than what IBM means when it uses this term in the documentation. Some users use this term to refer to utilities that leave the data available while they are running. For example, when you use the REORG TABLESPACE utility to reorganize data, you can specify the level of access that other applications and processes have to that same data. If you specify the SHRLEVEL CHANGE option, the data can be changed while the utility runs. Therefore, REORG TABLESPACE SHRLEVEL CHANGE is considered by some users to be an "online utility" because the data is never taken offline. However, IBM does not use the term this way.

Related concepts:

Part 2, “DB2 online utilities,” on page 15

Part 3, “DB2 stand-alone utilities,” on page 885

Related tasks:

Chapter 7, “Invoking DB2 online utilities,” on page 17

Chapter 37, “Invoking stand-alone utilities,” on page 887

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Chapter 2. DB2 utilities packaging

Several utilities are included with DB2 at no extra charge. Other utilities are available as a separate product.

The following utilities are core utilities, which are included (at no extra charge) with Version 11 of DB2 for z/OS:

- CATENFM
- CATMAINT
- DIAGNOSE
- LISTDEF
- OPTIONS
- QUIESCE
- REPAIR
- REPORT
- TEMPLATE
- All DSN stand-alone utilities

All other utilities are available as a separate product called the DB2 Utilities Suite for z/OS (5655-W87, FMID JDBBB1K), which includes the following utilities:

- BACKUP SYSTEM
- CHECK DATA
- CHECK INDEX
- CHECK LOB
- COPY
- COPYTOCOPY
- EXEC SQL
- LOAD
- MERGECOPY
- MODIFY RECOVERY
- MODIFY STATISTICS
- REBUILD INDEX
- RECOVER
- REORG INDEX
- REORG TABLESPACE
- RESTORE SYSTEM
- RUNSTATS
- STOSPACE
- UNLOAD

All DB2 utilities operate on catalog, directory, and sample objects, without requiring purchase of the DB2 Utilities Suite for z/OS.

SMP/E jobs for DB2 utility products

To load the DB2 utility products, use System Modification Program Extended (SMP/E). SMP/E processes the installation cartridges and creates DB2 distribution target libraries.

DB2 provides several jobs that invoke SMP/E. These jobs are on the cartridge that you received with the utility product. The job prologues in these jobs contain directions on how to tailor the job for your site. Follow these directions carefully to ensure that your DB2 Utilities Suite SMP/E process works correctly.

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The SMP/E RECEIVE job, DSNRECVK, loads the DB2 Utilities Suite Version 11 program modules, macros, and procedures into temporary data sets (SMPTLIBs). If these jobs fail or abnormally terminate, correct the problem and rerun the jobs.

The SMP/E APPLY job, DSNAPPLK, copies and link-edits the program modules, macros, and procedures for the DB2 Utilities Suite Version 11 into the DB2 target libraries.

The SMP/E ACCEPT job, DSNACCPK, copies the program modules, macros, and procedures for the DB2 Utilities Suite Version 11 into the DB2 distributed libraries.

Detailed instructions for installing the DB2 Utilities Suite is in the *DB2 Utilities Suite for z/OS Program Directory*.

Related concepts:

System installation and maintenance using SMP/E (z/OS basic skills)

Related information:

DB2 for z/OS Program Directories

Operation of DB2 utilities in a mixed-release data sharing environment

The utilities batch module, DSNUTILB, is split into multiple parts: a release-independent module called DSNUTILB, a release-dependent module DSNUT111, and utility-dependent load modules.

To operate in a mixed-release data sharing environment, you must have the following modules available to the utility jobs that operate across the data sharing group:

- The release-dependent modules from both releases
- All applicable utility-dependent modules

Related reference:

Load module names for running purchased utilities in coexistence (DB2 Installation and Migration)

Chapter 3. Privileges and authorization IDs for DB2 utilities

A utility job can be issued by an individual user, by a program that runs in batch mode, or by an IMS or CICS transaction. The term *process* describes any of these initiators.

DB2 processes are represented by a set of identifiers (IDs), which are called authorization IDs. What the process can do with DB2 is determined by the privileges and authorities that are held by its identifiers.

For DB2 online utilities, the process can be represented by the following identifiers:

- A primary authorization ID.
- Possibly one or more secondary IDs.
- A role, if the process is running in a trusted connection with an associated role.

For example, a process can have a secondary authorization ID that is a Resource Access Control Facility (RACF) group ID. Suppose that RACF group holds the LOAD privilege on a particular database. Any member of the group can run the LOAD utility to load table spaces in the database.

The privileges that are required for each utility are listed in the documentation for the utility.

Required authorizations for invoking utilities on tables that have multilevel security with row-level granularity

If you use RACF access control with multilevel security, you need additional authorizations to run the following utilities on tables that have multilevel security with row-level granularity:

- LOAD
- UNLOAD
- REORG TABLESPACE

The authorization requirements are listed in the documentation for each of these utilities.

All other utilities, including all stand-alone utilities, ignore the row-level granularity. They check only for authorization to operate on the table space; they do not check row-level authorization.

DB2 online utilities in a trusted connection

The DB2 online utilities can run in a trusted connection if both of the following conditions are true:

- A matching trusted context is defined where the primary authorization ID matches the trusted context SYSTEM AUTHID.
- The job name matches the JOBNAME attribute that is defined for the identified trusted context.

The primary authorization ID can acquire a special set of privileges in a trusted context, by roles.

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Related concepts:

Authorization IDs (Managing Security)

Privileges and authorities (Managing Security)

Multilevel security (Managing Security)

Related reference:

Processing of sign-on requests (Managing Security)

Related information:

Managing access through trusted contexts (Managing Security)

Chapter 4. Utilities that can be run on declared temporary objects

The REPAIR utility with the DBD option and the STOSPACE utility can be run on declared temporary objects.

You can use REPAIR DBD on declared temporary tables, which must be created in a database that is defined with the AS TEMP clause.

You can use STOSPACE on storage groups that have objects within temporary databases.

No other DB2 utilities can be used on a declared temporary table, its indexes, or its table spaces.

Related concepts:

Creation of temporary tables (Introduction to DB2 for z/OS)

Related tasks:

"Repairing DBDs" on page 686

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Chapter 5. Effect of utilities on objects that have the DEFINE NO attribute

You can run certain online utilities on table spaces or index spaces that were defined with the DEFINE NO attribute. When you specify this attribute, the table space or index space is defined; however, DB2 does not allocate the associated data sets until a row is inserted or loaded into a table in that table space.

You can populate table spaces whose data sets are not yet defined by using the LOAD utility with either the RESUME option or the REPLACE option. Using LOAD to populate these table spaces results in the following actions:

1. DB2 allocates the data sets.
2. DB2 updates the SPACE column in the catalog table to indicate that data sets exist.
3. DB2 loads the specified table space.

For a partitioned table space, all partitions are allocated even if the LOAD utility is loading only one partition. Avoid attempting to populate a partitioned table space with concurrent LOAD PART jobs until after one of the jobs causes all the data sets to be created.

Online utilities that encounter an undefined target object might issue informational message DSNU185I, but processing continues. The following online utilities issue this message when a table space or index space with the DEFINE NO attribute is encountered. The object is not processed.

- CHECK DATA
- CHECK INDEX
- COPY
- MERGECOPY
- MODIFY RECOVERY
- QUIESCE
- REBUILD INDEX
- RECOVER
- REORG INDEX
- REORG TABLESPACE[1]
- REPAIR, but not REPAIR DBD
- RUNSTATS TABLESPACE INDEX(ALL) [2]
- RUNSTATS INDEX [2]
- UNLOAD

Note:

1. REORG TABLESPACE processes the object if ROWFORMAT RRF is explicitly specified and the specified target is an entire undefined table space in basic row format. In this case, DB2 updates the row format definition in the catalog and directory. No data sets are defined for the table space.
2. RUNSTATS recognizes DEFINE NO objects and updates the catalog's access path statistics to reflect the empty objects.

You cannot use stand-alone utilities on objects whose data sets are not yet defined.

Related tasks:

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Deferring allocation of DB2-managed data sets (DB2 Administration Guide)

Related information:

DSNU185I (DB2 Messages)

Chapter 6. Effect of utilities on data that is encrypted through built-in functions

You can copy and recover encrypted data. You can also move encrypted data between systems. Data remains encrypted throughout these processes.

However, running any of the following utilities on encrypted data might produce unexpected results:

- CHECK DATA
- LOAD
- REBUILD INDEX
- REORG TABLESPACE
- REPAIR
- RUNSTATS
- UNLOAD
- DSN1PRNT

Related concepts:

Encrypting your data through DB2 built-in functions (Managing Security)

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Part 2. DB2 online utilities

DB2 online utilities run as standard batch jobs or stored procedures, and they require DB2 to be running. They do not run under control of the terminal monitor program (TMP); they have their own attachment mechanism and they invoke DB2 control facility services directly.

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Chapter 7. Invoking DB2 online utilities

You can invoke DB2 online utilities by using any of a variety of methods.

Before you begin

Make sure that you are authorized to run the utility that you want to invoke. You can check the authorization that is required in the documentation for each utility.

If any of following situations apply, check for any additional authorization restrictions or requirements in Chapter 3, "Privileges and authorization IDs for DB2 utilities," on page 7:

- The target object is a table that has multilevel security with row-level granularity.
- You plan to run the utilities in a trusted context.

About this task

Some utilities can operate at the partition level. For those utilities, any reference to a partition number denotes the physical partition number unless otherwise specified. Similarly, any partition numbers that are included in the utility output are the physical partition numbers.

Procedure

To run DB2 online utilities:

1. Prepare the necessary data sets. For more information about allocating data sets for utilities and a list of the data sets that are required for each utility, see "Data sets that online utilities use" on page 18.
2. Create a utility control statement. For general information about utility control statements, a list of the syntax for each utility, and a list of sample control statements, see "Utility control statements" on page 22.
3. Check for any concurrency and compatibility restrictions. These restrictions limit what other utilities and processes can run at the same time. For a list of restrictions, see "Utility concurrency and compatibility" on page 27.
4. Invoke the online utility by using one of the following methods:

   Requirement: In the JCL for all utility jobs, specify a load library (*prefix*.SDSNLOAD) that is at a maintenance level that is compatible with the DB2 subsystem. Otherwise, errors can occur.

   - "Invoking an online utility by using the DB2 Utilities panel in DB2I" on page 29

     This method requires little involvement with JCL. You can edit the generated JCL to alter or add necessary fields on the JOB or ROUTE statements before you submit the job.

     Requirement: To use this method, you must have TSO and access to the DB2 Utilities Panel in DB2 Interactive (DB2I).
   - "Invoking a DB2 utility by using the DSNU CLIST command in TSO" on page 34

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This method involves invoking the DSNU CLIST command to generate the JCL for you.

Requirement: To use this method, you must have TSO.

- Use the "The supplied JCL procedure (DSNUPROC) for invoking a DB2 online utility" on page 41

  This method involves working with or creating your own JCL.
- "Invoking a DB2 online utility by creating the JCL data set yourself" on page 44

  This method involves working with or creating your own JCL.
- Use the "DSNUTILU stored procedure" on page 1044.

  This method involves invoking online utilities from a DB2 application program by calling this stored procedure.

Data Sharing: When you submit a utility job, specify the name of the DB2 subsystem to which the utility is to attach, the group attachment name, or subgroup attachment name. If you do not use the group attachment name or subgroup attachment name, the utility job must run on the z/OS system where the specified DB2 subsystem is running. Ensure that the utility job runs on the appropriate z/OS system. To do so, use one of several z/OS installation-specific statements, such as:

- For JES2 multi-access spool (MAS) systems, insert the following statement into the utility JCL:

  ```
  /*JOBPARM SYSAFF=cccc
  ```
- For JES3 systems, insert the following statement into the utility JCL:

  ```
  //*MAIN SYSTEM=(main-name)
  ```

Your installation might have other mechanisms for controlling where batch jobs run, such as by using job classes.

Results

If the utility fails, you can either terminate it or restart it.

Related concepts:

Group attachment names and subgroup attachment names (DB2 Installation and Migration)

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

Data sets that online utilities use

Every online utility job requires a SYSIN DD statement to describe an input data set with the utility control statement; some utilities also require other data sets.

General rules for utility data sets

Data sets for utilities have the following requirements and restrictions:

For input data sets

DB2 online utilities use the logical record length (LRECL), the record format (RECFM) and the block size (BLKSIZE) with which the data set was created. Variable-spanned (VS) or variable-blocked-spanned (VBS) record formats are not allowed for utility input data sets. The only exceptions are

for the LOAD and UNLOAD utilities. These utilities use VBS data sets when you specify the FORMAT SPANNED YES option. Also, LOAD accepts VBS data sets when you specify the FORMAT SQL/DS option.

For output data sets

DB2 online utilities determine both the logical record length (LRECL) and the record format (RECFM). Any specified values for LRECL or RECFM are ignored. If you supply block size (BLKSIZE), that size is used; otherwise, the system determines the optimal block size for the storage device.

DB2 supports the large block interface (LBI), which allows block sizes that are greater than 32 KB on certain tape drives. UNLOAD SPANNED YES ignores LBI for output data sets.

The TAPEBLKSZLIM parameter of the DEVSUPxx member of SYS1.PARMLIB controls the block size limit for tapes.

Partitioned data sets (PDS) are not allowed for output data sets.

For output data sets for FlashCopy® image copies

DB2 online utilities determine the data set names by using the template that is provided. The output VSAM data sets are allocated during the processing of the DFSMSdss COPY command. The output data sets for FlashCopy image copies are always cataloged.

For both input and output data sets

DB2 online utilities use the value that you supply for the number of buffers (BUFNO), with a maximum of 99 buffers. The default number of buffers is 20. The utilities set the number of channel programs equal to the number of buffers. The parameters that specify the buffer size (BUFSIZE) and the number of channel programs (NCP) are ignored.

Increasing the number of buffers (BUFNO) can result in an increase in real storage usage and page fixing below the 16-MB line.

If you omit any data control block (DCB) parameters, the utilities choose default values.

Restriction: DB2 does not support the undefined record format (RECFM=U) for any data set.

Related information:

Data set record formats(z/OS basic skills)

DEVSUPxx (device support options) (MVS Initialization and Tuning Reference)

Large Block Interface (LBI) (z/OS DFSMS Using Data Sets)

DCB Subparameters (MVS JCL Reference)

Extended addressing support by DB2 utilities

DB2 utilities support the use of extended address volumes (EAV) for VSAM data sets and extended format (EF) sequential data sets.

Related information:

Extended Address Volumes (z/OS DFSMS Using Data Sets)

Data set concatenation

When you use DB2 utilities, you can concatenate unlike input data sets. The data sets in a concatenation list can have different block sizes, logical record lengths,

and record formats. If you want to concatenate variable and fixed-blocked data sets, the logical record length must be 8 bytes smaller than the block size.

You cannot concatenate output data sets.

Related information:

Concatenating Data Sets (MVS JCL User's Guide)

Data set disposition

Most data sets need to exist only during utility execution (for example, during reorganization). However, you must retain data sets in following circumstances:

- Retain the image copy data sets until you no longer need them for recovery.
- Retain the unload data sets if you specify UNLOAD PAUSE, UNLOAD ONLY, UNLOAD EXTERNAL, or DISCARD for the REORG utility.
- Retain the SYSPUNCH data set if you specify UNLOAD EXTERNAL or DISCARD for the REORG utility until you no longer need the contents for subsequent loads.
- Retain the discard data set until you no longer need the contents for subsequent loads.

Because you might need to restart a utility, take the following precautions when you define the disposition of data sets:

- Use DISP=(NEW,CATLG,CATLG) or DISP=(MOD,CATLG) for data sets that you want to retain.
- Use DISP=(MOD,DELETE,CATLG) for data sets that you want to discard after utility execution.
- Use DISP=(NEW,DELETE) for the SORTWK*nn* data sets for your sort program, or refer to the documentation for your sort program for alternatives.
- Do not use temporary data set names.

Related information:

DISP Parameter (MVS JCL Reference)

DFSORT Application Programming Guide

DB2 Sort

Preventing unauthorized access to data sets

To prevent unauthorized access to data sets (for example, image copies), you can protect the data sets with the Resource Access Control Facility (RACF) licensed program. To use a utility with a data set that is protected by RACF, you must be authorized to access the data set.

Related information:

Protecting data sets through RACF (Managing Security)

Data sets that are required by each utility

Use the following table to find the list of the data sets that are required for the particular utility that you want to use.

Table 1. Required utility data sets

Online utility	Required data sets
BACKUP SYSTEM	"Data sets that BACKUP SYSTEM uses" on page 64
CATENFM	"Data sets that CATENFM uses when converting the catalog" on page 70
CATMAINT	"Data sets that CATMAINT uses" on page 76
CHECK DATA	"Data sets that CHECK DATA uses" on page 92
CHECK INDEX	"Data sets that CHECK INDEX uses" on page 114
CHECK LOB	"Data sets that CHECK LOB uses" on page 131
COPY	"Data sets that COPY uses" on page 153
COPYTOCOPY	"Data sets that COPYTOCOPY uses" on page 197
DIAGNOSE	"Data sets that DIAGNOSE uses" on page 213
EXEC SQL	No required data sets.
LISTDEF	No required data sets.
LOAD	"Data sets that LOAD uses" on page 304
MERGECOPY	"Data sets that MERGECOPY uses" on page 377
MODIFY RECOVERY	"Data sets that MODIFY RECOVERY uses" on page 390
MODIFY STATISTICS	"Data sets that MODIFY STATISTICS uses" on page 402
OPTIONS	No required data sets.
QUIESCE	"Data sets that QUIESCE uses" on page 419
REBUILD INDEX	"Data sets that REBUILD INDEX uses" on page 440
RECOVER	"Data sets that RECOVER uses" on page 472
REORG INDEX	"Data sets that REORG INDEX uses" on page 533
REORG TABLESPACE	"Data sets that REORG TABLESPACE uses" on page 604
REPAIR	"Data sets that REPAIR uses" on page 681
REPORT	"Data sets that REPORT uses" on page 699
RESTORE SYSTEM	"Data sets that RESTORE SYSTEM uses" on page 732
RUNSTATS	"Data sets that RUNSTATS uses" on page 762
STOSPACE	"Data sets that STOSPACE uses" on page 784
TEMPLATE	No required data sets.
UNLOAD	"Data sets that UNLOAD uses" on page 857

Utility control statements

Utility control statements define the function that the utility job performs.

Create the utility control statements with the ISPF/PDF edit function and use the control statement coding rules that are listed. Save these control statements in a sequential or partitioned data set.

Control statement coding rules

DB2 typically reads utility control statements from the SYSIN data set. DB2 can read LISTDEF control statements from the SYSLISTD data set and TEMPLATE control statements from the SYSTEMPL data set. The statements in these data sets must obey the following rules:

- **Fixed-length records:** If the records are 80-character fixed-length records, DB2 ignores columns 73 through 80.
- **Statements that span records:** The records are concatenated before they are parsed; therefore, a statement or any of its syntactical constructs can span more than one record. No continuation character is necessary.

  However, if the input data set contains variable-length records, DB2 might interpret the part of a statement that is in column 1 as the continuation of the statement from the previous record. To avoid syntax errors, ensure that all syntactical constructs in utility control statements are properly delimited. Doing so is especially important for the first character in each record of a data set with variable-length records.
- **Character set encoding:** All control statements in a data set must be written entirely in a single character set. The following two character sets are supported: EBCDIC (code page 500) and Unicode UTF-8 (code page 1208). DB2 automatically detects and processes Unicode UTF-8 control statements if the first character of the data set is one of the following characters:
  - A Unicode UTF-8 blank (x'20')
  - A Unicode UTF-8 dash (x'2D')
  - A Unicode UTF-8 uppercase A through Z (x'41' through x'5A')

  In all other cases, the control statement data set is processed as EBCDIC. An informational message is issued to identify the character set that is being processed. Message DSNU1044I indicates that the statement is being processed as EBCDIC. Message DSNU1045I indicates that the statement is being processed as Unicode.

  The following EBCDIC characters have the same hexadecimal code point value as the Unicode UTF-8 characters J to P:

  ```
  ¢ . < ( + | &
  ```

  If any of these characters are the first character in the input data set, the control statement can be misinterpreted as Unicode. This error is a utility syntax error. However, these characters might cause Unicode to EBCDIC translation errors and abends before the syntax error is detected. After the syntax error is detected, message DSNU005I might contain indecipherable statements and message DSNU082I might identify an indecipherable keyword.

Related information:

Code pages and CCSIDs (DB2 Internationalization Guide)

EBCDIC (DB2 Internationalization Guide)

Unicode (DB2 Internationalization Guide)

DSNU1044I (DB2 Messages)

DSNU1045I (DB2 Messages)

DSNU005I (DB2 Messages)

DSNU082I (DB2 Messages)

- **Syntax:** The utility statement must start with the syntax for a utility. Other syntactical constructs in the utility control statement describe options; you can separate these constructs with an arbitrary number of blanks.
- **Options:** The options that you can specify after the online utility name depend on which online utility you use. To specify a utility option, specify the option keyword, followed by its associated parameter or parameters, if any. The parameter value can be a keyword. You need to enclose the values of some parameters in parentheses. The syntax diagrams for utility control statements show parentheses where they are required.

  Where the syntax of each utility control statement is described, parameters are indented under the option keyword that they must follow. The following option is a typical example:

  WORKDDN *ddname*

  Specifies a temporary work file.

  ddname is the data set name of the temporary file.

  The default value is **SYSUT1**.

  In the example, WORKDDN is an option keyword, and *ddname* is a variable parameter. You can enclose parameter values in parentheses, but parentheses are not always required. In this case, you can specify the temporary work file as either `WORKDDN SYSUT1` or `WORKDDN (SYSUT1)`.

  For the specific syntax and options for each utility, see "Control statement syntax" on page 25.

  For sample control statements for each utility, see "Control statement samples" on page 26.
- **Delimiter character and decimal character:** In a utility control statement, when you specify multiple numeric values that are meant to be delimited, you must delimit these values with a comma (","). You must use this delimiter regardless of the definition of DECIMAL in the application defaults load module (either DSNHDECP or a user-specified application defaults load module). Likewise, when you specify a decimal number in a utility control statement, you must use a period ("."), regardless of the definition of DECIMAL in the application defaults load module.

  Related information:

  DECIMAL POINT IS field (DECIMAL DECP value) (DB2 Installation and Migration)
- **Multiple utility control statements:** You can specify more than one utility control statement in the SYSIN stream. However, if any of the control statements return a return code of 8 or greater, the subsequent statements in the job step are not executed.
- **Comments:** You can enter comments within the SYSIN stream. Comments must begin with two hyphens (**--**) and are subject to the following rules:
  - You must use two hyphens on the same line with no space between them.
  - You can start comments wherever a space is valid, except within a delimiter token.
  - The end of a line terminates a comment.

Two comments are shown in the following statement:

```
// SYSIN DD *
RUNSTATS TABLESPACE DSNDB06.SYSDDF  -- COMMENT HERE
-- COMMENT HERE
/*
```

- **The concatenation operator:** Utility control statements support the || concatenation operator. The operator is allowed between two delimited character strings or between two non-delimited character strings. (Delimited character strings are enclosed in double quotation marks.) The result is a character string that consists of the string that is after the operator concatenated to the string that precedes the operator. The operation is shown in the following statement:

  ```
  string1  ||  string2
  ```

  Both *string1* and *string2* must be syntactically correct within each SYSIN input record. Quotation marks must be balanced within each string. If DBCS characters are used, shift-out and shift-in characters must be balanced within each string. Any one multi-byte character must be contained entirely within a single SYSIN record.

  The || operator must be entered as a stand-alone token, with one or more blanks before and after it. It can be entered on the same input record as *"string1"*, alone on an input record, or on the same input record with *"string2"*. This operator functions at the token level before any context is detected or semantic meaning is applied. An example utility statement is shown in the following statement:

  ```
  COPY  INDEX
         "A" ||
         "B"
  results in:
         COPY INDEX   "AB"
  ```

  The utility || operator is ignored in an EXEC SQL control statement by utility processing, because the operator has an existing SQL meaning. The operators remain part of the SQL statement for subsequent processing by SQL.Another example of the || concatenation operator is shown in the following statement:

  ```
  LOAD INTO TABLE
  CREA ||
  TOR.
  "TABL" ||
  "ENAME"
  ```

  In this example, the strings CREA and TOR are non-delimited, and the strings TABL and ENAME are delimited by double quotation marks. The processed output of this example is equivalent to the following statement:

  ```
  LOAD INTO TABLE CREATOR."TABLENAME"
  ```

Tips for using multi-byte character sets in control statements

Multi-byte character sets can be difficult to work with in fixed 80-byte SYSIN data sets. Long object names and long character literals might not fit on a single line.

Where possible, avoid having to break object names or character literals by using the following techniques:

- Use a SYSIN data set with variable length records or sufficiently large record length.
- Use shorter object names. The longer the name, the more likely continuation issues arise.
- If possible, process the object by space name (table space or index space) and avoid specifying long multi-byte table and index names in utility syntax.

If necessary, use one of the following continuation techniques:

- Shift the starting point of the string to the left or right within the input record so that a complete multi-byte character ends in column 72. Continue with the next character in column 1 of the next input record.
- Separate qualified object names into two parts following the dot ".", which separates the qualifiers. Separating long names into multiple parts makes it easier to follow the continuation rules. This technique cannot be used in the EXEC SQL utility, which must follow both utility and SQL syntax rules.
- Use the || concatenation operator to divide long identifiers into two or more parts that fit properly into each SYSIN record.

Control statement syntax

Use the following table to find the control statement syntax for the particular utility that you want to use.

Table 2. Utility control statement syntax and options

Online utility	Control statement syntax and options
BACKUP SYSTEM	"Syntax and options of the BACKUP SYSTEM control statement" on page 60
CATENFM	"Syntax and options of the CATENFM control statement" on page 69
CATMAINT	"Syntax and options of the CATMAINT control statement" on page 73
CHECK DATA	"Syntax and options of the CHECK DATA control statement" on page 80
CHECK INDEX	"Syntax and options of the CHECK INDEX control statement" on page 110
CHECK LOB	"Syntax and options of the CHECK LOB control statement" on page 128
COPY	"Syntax and options of the COPY control statement" on page 141
COPYTOCOPY	"Syntax and options of the COPYTOCOPY control statement" on page 192
DIAGNOSE	"Syntax and options of the DIAGNOSE control statement" on page 209
EXEC SQL	"Syntax and options of the EXEC SQL control statement" on page 217
LISTDEF	"Syntax and options of the LISTDEF control statement" on page 221
LOAD	"Syntax and options of the LOAD control statement" on page 247
MERGECOPY	"Syntax and options of the MERGECOPY control statement" on page 374
MODIFY RECOVERY	"Syntax and options of the MODIFY RECOVERY control statement" on page 387
MODIFY STATISTICS	"Syntax and options of the MODIFY STATISTICS control statement" on page 400
OPTIONS	"Syntax and options of the OPTIONS control statement" on page 407

Table 2. Utility control statement syntax and options (continued)

Online utility	Control statement syntax and options
QUIESCE	"Syntax and options of the QUIESCE control statement" on page 416
REBUILD INDEX	"Syntax and options of the REBUILD INDEX control statement" on page 428
RECOVER	"Syntax and options of the RECOVER control statement" on page 460
REORG INDEX	"Syntax and options of the REORG INDEX control statement" on page 514
REORG TABLESPACE	"Syntax and options of the REORG TABLESPACE control statement" on page 555
REPAIR	"Syntax and options of the REPAIR control statement" on page 664
REPORT	"Syntax and options of the REPORT control statement" on page 695
RESTORE SYSTEM	"Syntax and options of the RESTORE SYSTEM control statement" on page 728
RUNSTATS	"Syntax and options of the RUNSTATS control statement" on page 739
STOSPACE	"Syntax and options of the STOSPACE control statement" on page 784
TEMPLATE	"Syntax and options of the TEMPLATE control statement" on page 789
UNLOAD	"Syntax and options of the UNLOAD control statement" on page 818

Control statement samples

Use the following table to find sample control statements for the particular utility that you want to use.

Table 3. Sample utility control statements

Online utility	Sample utility control statements
BACKUP SYSTEM	"Sample BACKUP SYSTEM control statements" on page 66
CATENFM	See the DSNTIJEN installation job.
CATMAINT	See the DSNTIJTC installation job.
CHECK DATA	"Sample CHECK DATA control statements" on page 104
CHECK INDEX	"Sample CHECK INDEX control statements" on page 124
CHECK LOB	"Sample CHECK LOB control statements" on page 136
COPY	"Sample COPY control statements" on page 179
COPYTOCOPY	"Sample COPYTOCOPY control statements" on page 205

Table 3. Sample utility control statements (continued)

Online utility	Sample utility control statements
DIAGNOSE	"Sample DIAGNOSE control statements" on page 214
EXEC SQL	"Sample EXEC SQL control statements" on page 219
LISTDEF	"Sample LISTDEF control statements" on page 240
LOAD	"Sample LOAD control statements" on page 359
MERGECOPY	"Sample MERGECOPY control statements" on page 381
MODIFY RECOVERY	"Sample MODIFY RECOVERY control statements" on page 395
MODIFY STATISTICS	"Sample MODIFY STATISTICS control statements" on page 404
OPTIONS	"Sample OPTIONS control statements" on page 412
QUIESCE	"Sample QUIESCE control statements" on page 423
REBUILD INDEX	"Sample REBUILD INDEX control statements" on page 454
RECOVER	"Sample RECOVER control statements" on page 509
REORG INDEX	"Sample REORG INDEX control statements" on page 547
REORG TABLESPACE	"Sample REORG TABLESPACE control statements" on page 649
REPAIR	"Sample REPAIR control statements" on page 689
REPORT	"Sample REPORT control statements" on page 710
RESTORE SYSTEM	"Sample RESTORE SYSTEM control statements" on page 735
RUNSTATS	"Sample RUNSTATS control statements" on page 777
STOSPACE	"Sample STOSPACE control statement" on page 787
TEMPLATE	"Sample TEMPLATE control statements" on page 811
UNLOAD	"Sample UNLOAD control statements" on page 878

Utility concurrency and compatibility

Some online utilities allow other utilities and SQL statements to run concurrently on the same target object.

To determine whether utilities can be run concurrently, see the compatibility and concurrency information in the following table. Most of these concurrency and compatibility topics include the following information:

- For each target object, the claim classes that the utility must claim or drain and any restrictive state that the utility sets on the target object.
- For other online utilities, the compatibility of the utility with the same target object. If two actions are compatible on a target object, they can run simultaneously on that object in separate applications. If compatibility depends on particular options of a utility, that dependency is noted.

Table 4. Utility compatibility and concurrency

Online utility	Compatibility and concurrency information
BACKUP SYSTEM	"Concurrency and compatibility for BACKUP SYSTEM" on page 64
CATENFM	"Concurrency and compatibility for CATENFM" on page 71
CATMAINT	"Concurrency and compatibility for CATMAINT" on page 76
CHECK DATA	"Concurrency and compatibility for CHECK DATA" on page 96
CHECK INDEX	"Concurrency and compatibility for CHECK INDEX" on page 117
CHECK LOB	"Concurrency and compatibility for CHECK LOB" on page 134
COPY	"Concurrency and compatibility for COPY" on page 156
COPYTOCOPY	"Concurrency and compatibility for COPYTOCOPY" on page 199
DIAGNOSE	"Concurrency and compatibility for DIAGNOSE" on page 213
EXEC SQL	"Concurrency and compatibility for EXEC SQL" on page 219.
LISTDEF	"Concurrency and compatibility for LISTDEF" on page 231
LOAD	"Concurrency and compatibility for LOAD" on page 309
MERGECOPY	"Concurrency and compatibility for MERGECOPY" on page 378
MODIFY RECOVERY	"Concurrency and compatibility for MODIFY RECOVERY" on page 391
MODIFY STATISTICS	"Concurrency and compatibility for MODIFY STATISTICS" on page 402
OPTIONS	"Concurrency and compatibility for OPTIONS" on page 410
QUIESCE	"Concurrency and compatibility for QUIESCE" on page 419
REBUILD INDEX	"Concurrency and compatibility for REBUILD INDEX" on page 442
RECOVER	"Concurrency and compatibility for RECOVER" on page 472

Table 4. Utility compatibility and concurrency (continued)

Online utility	Compatibility and concurrency information
REORG INDEX	"Concurrency and compatibility for REORG INDEX" on page 537
REORG TABLESPACE	"Concurrency and compatibility for REORG TABLESPACE" on page 612
REPAIR	"Concurrency and compatibility for REPAIR" on page 682
REPORT	"Concurrency and compatibility for REPORT" on page 699
RESTORE SYSTEM	"Concurrency and compatibility for RESTORE SYSTEM" on page 733
RUNSTATS	"Concurrency and compatibility for RUNSTATS" on page 764
STOSPACE	"Concurrency and compatibility for STOSPACE" on page 785
TEMPLATE	"Concurrency and compatibility for TEMPLATE" on page 806
UNLOAD	"Concurrency and compatibility for UNLOAD" on page 858

If the utility supports parallelism, it can use additional threads to support the parallel subtasking. Consider increasing the values of subsystem parameters that control threads, such as MAX BATCH CONNECT and MAX USERS.

Related concepts:

Claims and drains (DB2 Performance)

Related reference:

MAX BATCH CONNECT field (IDBACK subsystem parameter) (DB2 Installation and Migration)

MAX USERS field (CTHREAD subsystem parameter) (DB2 Installation and Migration)

Invoking an online utility by using the DB2 Utilities panel in DB2I

One way to invoke DB2 online utilities is to use the DB2 Utilities panel. Consider using this method if you do not have much JCL knowledge.

Restriction: You cannot use the DB2 Utilities panel in DB2I to submit the following utility jobs:

- a BACKUP SYSTEM job
- a COPYTOCOPY job
- a RESTORE SYSTEM job
- a COPY job for a list of objects.

Procedure

To invoke an online utility by using the DB2 Utilities panel in DB2I:

1. Create the utility control statement for the online utility that you want to invoke, and save it in a sequential or partitioned data set. For more information about utility control statements, see "Utility control statements" on page 22.

   Example scenario: Save the following COPY utility control statement in the UTIL data set. (The UTIL data set is the default statement data set on the DB2 Utilities panel.)

   ```
   COPY TABLESPACE DSN8D11A.DSN8S11D
     FULL NO
     SHRLEVEL CHANGE
   ```

2. From the **ISPF Primary Option** menu, select the **DB2I** menu.
3. On the DB2I panel, select the **UTILITIES** option.

   The DB2 Utilities panel is displayed. Items that you must specify are highlighted in the following figure:

```
DSNEUP01                        DB2 UTILITIES
 ===>

 Select from the following:

  1 FUNCTION ===> EDITJCL   (SUBMIT job, EDITJCL, DISPLAY, TERMINATE)
  2 JOB ID   ===> TEMP      (A unique job identifier string)
  3 UTILITY  ===> COPY      (CHECK DATA, CHECK INDEX, CHECK LOB,

                             COPY, DIAGNOSE, LOAD, MERGE, MODIFY,
                             QUIESCE, REBUILD, RECOVER, REORG INDEX,
                             REORG LOB, REORG TABLESPACE, REPORT,
                             REPAIR, RUNSTATS, STOSPACE, UNLOAD.)

  4 STATEMENT DATA SET  ===>   UTIL

 Specify restart or preview option, otherwise specify NO.

  5 RESTART  ===> NO         (NO, CURRENT, PHASE or PREVIEW)

  6 LISTDEF? (YES|NO) ===> NO       TEMPLATE? (YES|NO) ===> NO

  7 LIB ==>                  (BLANK or DB2 LIB NAME)

*  The data set names panel will be displayed when required by a utility.


 PRESS:  ENTER to process     END to exit    HELP for more information
```

Figure 1. DB2 Utilities panel

4. Complete the fields as follows and press **Enter**:

   Field 1

   Specify one of the following options:

   SUBMIT

   The generated JCL is submitted for processing after you complete this panel and any subsequent panels. You cannot edit the JCL.

   EDITJCL

   You can edit the generated JCL before you submit the utility job.

   If your site does not have default JOB and ROUTE statements, you must edit the JCL to define them.

The other two options for this field, DISPLAY and TERMINATE, are not part of invoking a utility. DISPLAY performs the same function as the DISPLAY UTILITY command; it shows the status of a utility job. TERMINATE performs the same function as the TERM UTILITY command; it terminates a utility.

Example scenario: Specify `EDITJCL`.

Field 2

Specify a unique identifier for your utility job. The default value is TEMP.

Example scenario: The default TEMP value is satisfactory; leave it as is.

Field 3

Specify the utility that you want to run.

Example scenario: Specify `COPY`.

Field 4

Specify the data set that contains the utility control statement. Unless you enclose the data set name between apostrophes, TSO adds your user identifier as a prefix. The default data set is UTIL.

Example scenario: Leave the default value `UTIL`.

Field 5

If you want to restart a stopped utility, specify CURRENT or PHASE. If you want to run a utility in PREVIEW mode, specify PREVIEW. Otherwise, leave the default value of NO.

Example scenario: Leave the default value, NO.

Field 6

Specify whether you are using LISTDEF statements or TEMPLATE statements for this utility job.

Example scenario: Specify NO.

Field 7

If you want the generated JCL to use a DB2 subsystem library other than the default, specify the data set name of the DB2 subsystem library.

Example scenario: Leave this field blank.

5. If the Data Set Names panel is displayed, complete the fields on that panel. This panel is displayed if you specified COPY, LOAD, MERGECOPY, REORG TABLESPACE, or UNLOAD on the DB2 Utilities panel as the utility that you want to invoke.

```
DSNEUP02                        DATA SET NAMES
 ===>

   Enter data set name for LOAD or REORG TABLESPACE:
1 RECDSN   ==>

   Enter data set name for
LOAD, REORG TABLESPACE or UNLOAD:
2 DISCDSN  ==>

   Enter output data sets for local/current site for COPY, MERGECOPY,
     LOAD, or REORG:
3 COPYDSN  ==> ABC
4 COPYDSN2 ==>

   Enter output data sets for recovery site for COPY, LOAD, or REORG:
5 RCPYDSN1 ==> ABC1
6 RCPYDSN2 ==>
   Enter output data sets for REORG or UNLOAD:
7 PUNCHDSN ==>
 PRESS:  ENTER to process     END to exit    HELP for more information
```

Figure 2. Data Set Names panel

Complete the field as follows and press **Enter**:

Field 1

Complete this field if you are running LOAD, REORG TABLESPACE, or UNLOAD. For LOAD, specify the data set name that contains the records that are to be loaded. For REORG TABLESPACE or UNLOAD, specify the unload data set.

Example scenario: You do not need to complete field 1, because you are running COPY.

Field 2

If you are running LOAD or REORG TABLESPACE with discard processing, specify a discard data set.

Example scenario: You do not need to complete field 1, because you are running COPY.

Field 3

Complete this field as follows:

- If you are running COPY, LOAD, or REORG TABLESPACE, specify the primary output data set name for the local site.
- If you are running MERGECOPY, specify the primary output data set name for the current site.

The DD name that the panel generates for this field is SYSCOPY. This field is optional for the following jobs:

- LOAD
- REORG TABLESPACE with the SHRLEVEL NONE option

This field is required for the following jobs:

- COPY
- MERGECOPY
- REORG TABLESPACE with the SHRLEVEL REFERENCE or SHRLEVEL CHANGE options.

Example scenario: Specify ABC as the primary output data set name for the local site.

Field 4

Complete this field as follows:

- If you are running COPY, LOAD, or REORG TABLESPACE, specify the backup output data set name for the local site.
- If you are running MERGECOPY, specify the backup output data set name for the current site.

The DD name that the panel generates for this field is SYSCOPY2. This field is an optional field.

Example scenario: Leave this field blank.

Field 5

If you are running COPY, LOAD, or REORG TABLESPACE, specify the primary output data set for the recovery site. The DD name that the panel generates for this field is SYSRCOPY1. This field is optional.

Example scenario: Specify ABC1 as the primary output data set name for the recovery site.

Field 6

If you are running COPY, LOAD, or REORG TABLESPACE, specify the backup output data set for the recovery site. The DD name that the panel generates for this field is SYSRCOPY2. This field is optional.

Example scenario: Leave this field blank.

Field 7

If you are running any of the following utility jobs, specify the output data set for the generated LOAD utility control statements:

- REORG TABLESPACE with the UNLOAD EXTERNAL or DISCARD options
- UNLOAD

The DD name that the panel generates for this field is SYSPUNCH.

Example scenario: Leave this field blank.

6. If the Control Statement Data Set Names panel is displayed, complete the fields on that panel. The field entries are optional. This panel is displayed if you specified YES in the **LISTDEF** field or **TEMPLATE** field on the DB2 Utilities panel.

```
DSNEUP03         CONTROL STATEMENT DATA SET NAMES            SSID:
===>

Enter the data set name for the LISTDEF data set (SYSLISTD DD):
 1 LISTDEF DSN  ===>
    OPTIONAL or IGNORED

Enter the data set name for the TEMPLATE data set (SYSTEMPL DD):
 2 TEMPLATE DSN ===>
    OPTIONAL or IGNORED


PRESS:  ENTER to process     END to exit   HELP for more information
```

Figure 3. Control Statement Data Set Names panel

Complete the fields as follows and press **Enter**:

Field 1
Specify the data set that contains a LISTDEF control statement. The default is the SYSIN data set. This field is ignored if you specified NO in the **LISTDEF** field in the DB2 Utilities panel.

Field 2
Specify the data set that contains a TEMPLATE control statement. The default is the SYSIN data set. This field is ignored if you specified NO in the **TEMPLATE** field in the DB2 Utilities panel.

7. If the JCL is displayed, edit the JCL as needed and then type `SUBMIT` on the editor command line. The JCL is displayed if you selected EDITJCL in field 1 on the DB2 Utilities panel. Otherwise, if you selected SUBMIT in field 1, the JCL is not displayed for editing.

Results

The generated JCL is submitted. You can view the output of the job as you normally would view the output of any batch job on your system. One common way is by using System Display and Search Facility (SDSF).

Related concepts:

What is SDSF? (z/OS basic skills)

Related reference:

Chapter 19, “LISTDEF,” on page 221

Chapter 35, “TEMPLATE,” on page 789

Invoking a DB2 utility by using the DSNU CLIST command in TSO

One way to run a DB2 online utility is to invoke the DSNU CLIST command under TSO. The CLIST command generates a JCL data set that invokes the DSNUPROC procedure to execute utilities as batch jobs.

Restriction: You cannot use the DSNU CLIST command to submit a COPY job for a list of objects.

Before you begin

Ensure that the DB2 CLIST library (*prefix*.SDSNCLST) is allocated to the DD name SYSPROC in the startup procedure for your TSO session.

About this task

The CLIST command creates a job that performs only one utility operation. However, you can invoke the CLIST command for each utility operation that you need, and then edit and merge all of the output into one job or step.

Procedure

To invoke a DB2 utility by using the DSNU CLIST command in TSO:

1. Create a file that contains the utility control statements. DB2 uses the file to create the SYSIN data set in the generated job stream. Do not include double-byte character set (DBCS) data in this file.
2. Execute the command procedure by using the “DSNU CLIST command syntax” on page 36. If you want to be able to edit the generated JCL, specify EDIT(SPF) or EDIT(TSO) on the command.

DSNU generates the JCL in a data set that is named DSNU*xxx*.CNTL, where DSNU*xxx* is a control file name. The control file contains the statements that are necessary to invoke the DSNUPROC procedure, which, in turn, executes the utility. If you execute another job with the same utility name, the first job is deleted. For a list of the control file name that is associated with each utility, see Table 5 on page 39.

For a description of the output, see "DSNU CLIST command output" on page 40.

3. Optional: Edit the generated JCL data set.

   You can add a JCL statement to the job stream, change JCL parameters (such as DD names), or change utility control statements.

   If your utility control statement specifies a DD name value that is not the default value, you must change the DD name in the generated JCL. For example, in the REORG TABLESPACE utility, the UNLDDN option specifies the name of the unload data set. The default value for UNLDDN is the DD name SYSREC. Therefore, DSNU builds a SYSREC DD statement for REORG TABLESPACE. If you use a different value for UNLDDN, you must edit the JCL data set and change SYSREC to the DD name value that you used.

4. Optional: Rename the JCL data set.

   DSNU reuses the temporary data set that contains the JCL for subsequent jobs with the same utility name. If you want to submit more than one job that executes the same utility, rename the JCL data sets and submit them separately.

Results

The job is submitted based on the value that you specified for the SUBMIT parameter.

Examples

Example 1: Invoking the DSNU CLIST command for the REORG TABLESPSACE utility

The following CLIST command statement generates a data set that is called *authorization-id*.DSNURGT.CNTL and that contains JCL statements that invoke the DSNUPROC procedure.

```
%DSNU UTILITY(REORG TABLESPACE) INDSN(MYREOR.DATA)
  RECDSN(MYREOR.WORK) RESTART(NO)
  EDIT(TSO) SUBMIT(YES)
```

The DSNUPROC procedure invokes the REORG TABLESPACE utility. The MYREOR.DATA data set is merged into the JCL data set as SYSIN input. MYREOR.WORK is a temporary data set that is required by REORG TABLESPACE. The TSO editor is invoked to allow editing of the JCL data set, *authorization-id*.DSNURGT.CNTL. The TSO editor then submits the JCL data set as a batch job. This JCL data set is not modified by this CLIST command statement until a new request is made to execute the REORG TABLESPACE utility.

Example 2: Invoking the DSNU CLIST command for the COPY utility

The following example shows how to invoke the CLIST command for the COPY utility.

```
%DSNU
  UTILITY (COPY)
  INDSN ('MYCOPY(STATEMNT)')
  COPYDSN ('MYCOPIES.DSN8D11A.JAN1')
```

```
EDIT (TSO)
SUBMIT (YES)
UID (TEMP)
RESTART (NO)
```

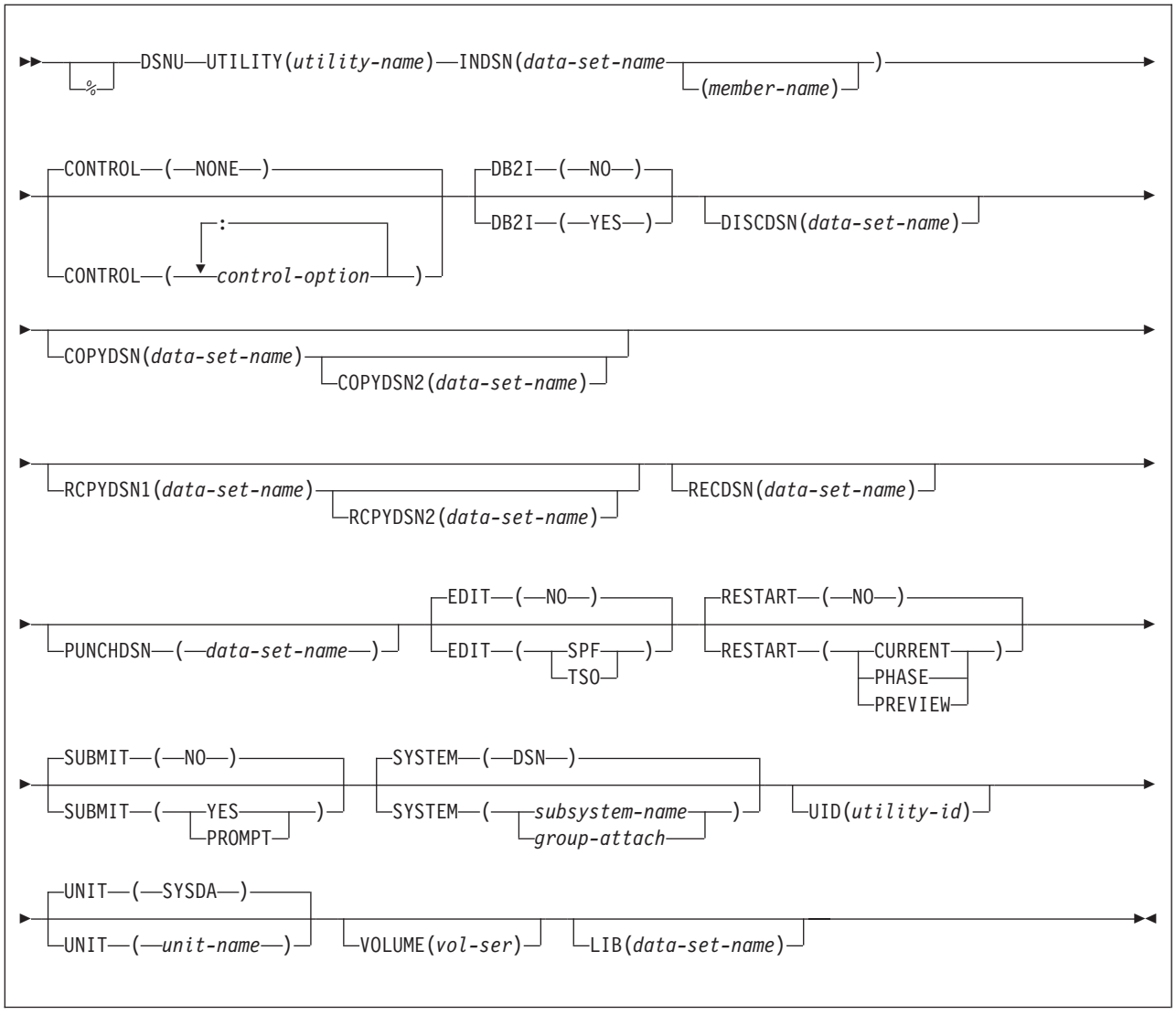
Related reference:

"The supplied JCL procedure (DSNUPROC) for invoking a DB2 online utility" on page 41

DSNU CLIST command syntax

You can execute the DSNU CLIST command from the TSO command processor or from the DB2I Utilities panel.

Syntax



DSNU CLIST option descriptions

The parentheses that are shown in the following descriptions are required. If you make syntax errors or omit parameter values, TSO prompts you for the correct parameter spelling and omitted values.

% Identifies DSNU as a member of a command procedure library. Specifying this parameter is optional; however, it does improve performance.

UTILITY (*utility-name***)**
Specifies the utility that you want to execute.

For a list of the online utilities and the control file name that is associated with each utility, see Table 5 on page 39.

INDSN(*data-set-name***(***member-name***))**
Specifies the data set that contains the utility statements and control statements. Do not specify a data set that contains double-byte character set data.

(*data-set-name***)**
Specifies the name of the data set. If you do not specify a data set name, the default command procedure prompts you for the data set name.

(*member-name***)**
Specifies the member name. You must specify the member name if the data set is partitioned.

CONTROL(*control-option***: ...)**
Specifies whether to trace the CLIST command execution.

NONE
Omits tracing.

control-option
Lists one or more of the following options. Separate items in the list by colons (:). To abbreviate, specify only the first letter of the option.

LIST Displays TSO commands after symbolic substitution and before command execution.

CONLIST
Displays CLIST commands after symbolic substitution and before command execution.

SYMLIST
Displays all executable statements (TSO commands and CLIST statements) before the scan for symbolic substitution.

NONE
Generates a CONTROL statement with the options NOLIST, NOCONLIST, and NOSYMLIST.

DB2I
Indicates the environment from which the DSNU CLIST command is called.

(NO)
Indicates that DSNU CLIST command is not being called from the DB2I environment.

(YES)
Indicates that DSNU CLIST command is called from the DB2I environment. Only the utility panels are to execute the CLIST command with DB2I(YES).

DISCDSN (*data-set-name***)**
The name of the cataloged data set that LOAD and REORG use for a discard data set. For LOAD, this data set holds records that are not loaded; for REORG, it holds records that are not reloaded.

COPYDSN(*data-set-name***)**
The name of the cataloged data set that DB2 utilities use as a target (output) data set. If you do not supply this information, the CLIST command prompts you for it. This keyword is optional for LOAD and for REORG with SHRLEVEL NONE; it is required for COPY, for MERGECOPY, and for REORG with SHRLEVEL REFERENCE or CHANGE.

COPYDSN2 (*data-set-name***)**
The name of the cataloged data set that DB2 utilities use as a target (output) data set for the backup copy. This keyword is optional for COPY, MERGECOPY, LOAD, and REORG.

RCPYDSN1 (*data-set-name***)**
The name of the cataloged data set that DB2 utilities use as a target (output) data set for the remote-site primary copy. This keyword is optional for COPY, LOAD, and REORG.

RCPYDSN2 (*data-set-name***)**
The name of the cataloged data set that DB2 utilities use as a target (output) data set for the remote-site backup copy. This keyword is optional for COPY, LOAD, and REORG.

RECDSN (*data-set-name***)**
The name of the cataloged data set that LOAD uses for input or that REORG TABLESPACE or UNLOAD use as the unload data set. If you do not supply this information, the CLIST command prompts you for it. This keyword is required for LOAD and REORG TABLESPACE only.

PUNCHDSN (*data-set-name***)**
The name of the cataloged data set that REORG or UNLOAD use to hold the generated LOAD utility control statements for UNLOAD EXTERNAL or DISCARD.

EDIT
Specifies whether to invoke an editor to edit the temporary file that the CLIST command generates.

(NO)
Does not invoke an editor.

(SPF)
Invokes the ISPF editor.

(TSO)
Invokes the TSO editor.

RESTART
Specifies whether this job restarts a current utility job, and, if so, at what point it is to be restarted.

(NO)
Indicates that the utility is a new job, not a restarted job. The utility identifier (UID) must be unique for each utility job step.

(CURRENT)
Restarts the utility at the most recent commit point.

(PHASE)
Restarts the utility at the beginning of the current stopped phase. You can determine the current stopped phase by issuing the DISPLAY UTILITY command.

(PREVIEW)
Restarts the utility in PREVIEW mode. While in PREVIEW mode, the utility checks for syntax errors in all utility control statements, but normal utility execution does not take place.

SUBMIT
Specifies whether to submit the generated JCL for processing.

(NO)
Does not submit the JCL data set for processing.

(YES)
Submits the JCL data set for background processing by using the TSO SUBMIT command.

(PROMPT)
Prompts you, after the data set is processed, to specify whether to submit the JCL data set for batch processing. You cannot use PROMPT when the CLIST command is executed in the TSO batch environment.

SYSTEM (*subsystem-name***)**
Specifies the DB2 subsystem or group attachment name or subgroup attachment name. The default value is **DSN**.

UID (*utility-id***)**
Provides a unique identifier for this utility job within DB2. Do not reuse the utility ID of a stopped utility that has not yet been terminated, unless you want to restart that utility. If you do use the same utility ID to invoke a different utility, DB2 tries to restart the original stopped utility with the information that is stored in the SYSUTIL directory table.

The default value is *tso-userid.control-file-name*, where *control-file-name* for each of the utilities is listed in the following table.

Table 5. Control-file name for each utility

Utility	*control-file-name*
CHECK INDEX	DSNUCHI
CHECK DATA	DSNUCHD
CHECK LOB	DSNUCHL
COPY	DSNUCOP
DIAGNOSE	DSNUDIA
LOAD	DSNULOA
MERGECOPY	DSNUMER
MODIFY	DSNUMOD
QUIESCE	DSNUQUI
REBUILD INDEX	DSNUREB
RECOVER	DSNUREC
REORG INDEX	DSNURGI
REORG LOB	DSNURGL
REORG TABLESPACE	DSNURGT
REPAIR	DSNUREP
REPORT	DSNURPT
RUNSTATS	DSNURUN

Table 5. Control-file name for each utility (continued)

Utility	*control-file-name*
STOSPACE	DSNUSTO
UNLOAD	DSNUUNL

UNIT (*unit-name***)**
Assigns a unit address, a generic device type, or a user-assigned group name for a device on which a new temporary or permanent data set resides. When the CLIST command generates the JCL, it places *unit-name* after the UNIT clause of the generated DD statement.

The default value is **SYSDA**.

VOLUME (*vol-ser***)**
Assigns the serial number of the volume on which a new temporary or permanent data set resides. When the CLIST command generates the JCL, it places *vol-ser* after the VOL=SER clause of the generated DD statement. If you omit VOLUME, the VOL=SER clause is omitted from the generated DD statement.

LIB (*data-set-name***)**
Specifies the data set name of the DB2 subsystem library. The value that you specify is used as the LIB parameter value when the DSNUPROC JCL procedure is invoked.

Related reference:
"DSNU CLIST command output"

DSNU CLIST command output

The DSNU CLIST command builds a one-step job stream. The generated JCL consists of a JOB statement, an EXEC statement that executes the DB2 utility processor, and the required DD statements. The JOB statement also includes the SYSIN DD * job stream. You can edit any of these statements.

The following figure shows example JCL that the DSNU CLIST command generates.

```
//DSNUCOP JOB your-job-statement-parameters
//          USER=userid,PASSWORD=password
//*ROUTE PRINT routing-information
//UTIL      EXEC  DSNUPROC,SYSTEM=DSN,UID=TEMP,UTPROC='
//SYSCOPY   DD    DSN=MYCOPIES.DSN8D11A.JAN1,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSIN     DD    *
     COPY TABLESPACE DSN8D11A.DSN8S11D
          FULL NO
          SHRLEVEL CHANGE

/*
```

Figure 4. Control file DSNUCOP.CNTL. This example shows the generated JCL data set before editing.

The JCL includes the following statements:

JOB The CLIST command uses any JOB statements that you saved when using DB2I. If no JOB statements exist, DB2 produces a skeleton JOB statement that you can modify. The job name is DSNU, followed by the first three letters of the name of the utility that you are using.

EXEC The CLIST command builds the EXEC statement. The values that you specified for the SYSTEM, UID, and RESTART command options become the values of the SYSTEM, UID, and UTPROC parameters for DSNUPROC.

The CLIST command also builds the necessary JCL DD statements. Those statements vary depending on the utility that you execute. The following DD statements are generated by the CLIST command:

SYSPRINT DD SYSOUT=A
Defines OUTPUT, SYSPRINT as SYSOUT=A. Utility messages are sent to the SYSPRINT data set. You can use the TSO ALLOCATE command to control the disposition of the SYSPRINT data set. For example, you can send the data set to your terminal.

UTPRINT DD SYSOUT=A
Defines UTPRINT as SYSOUT=A. If any utility requires a sort, it executes the sort program. Messages from that program are sent to UTPRINT.

SYSIN DD *
Defines SYSIN. To build the SYSIN DD * job stream, DSNU copies the data set that is named by the INDSN parameter. The INDSN data set does not change, and you can reuse it when the DSNU procedure finishes running.

Related reference:

DB2 Sort

ALLOCATE command (TSO/E Command Reference)

Related information:

DFSORT Application Programming Guide

The supplied JCL procedure (DSNUPROC) for invoking a DB2 online utility

One way to invoke a DB2 online utility is to use the supplied JCL procedure, DSNUPROC. DSNUPROC is a standard set of JCL that IBM provides to invoke online utilities. The advantage of using DSNUPROC is that it limits the amount of JCL that you need to write.

You customize this JCL procedure at installation time (in SYS1.PROCLIB).

Executing DSNUPROC

To execute the DSNUPROC procedure, write and submit a JCL data set that contains the following statements:

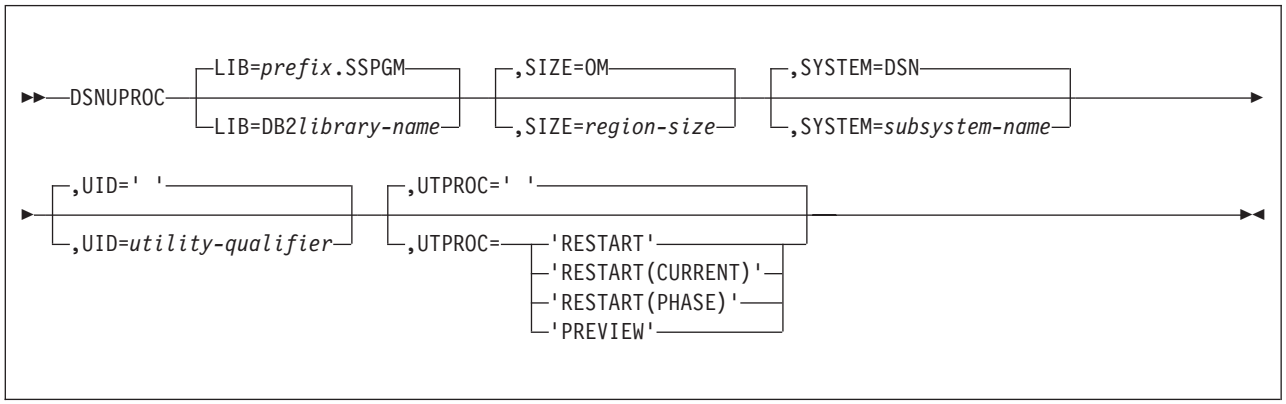
- An EXEC statement that specifies DSNUPROC and any parameters that you want. Possible parameters are listed in “DSNUPROC syntax” on page 42.
- A SYSIN DD statement for the utility control statements.
- DD statements for any other data sets that your job needs except for SYSPRINT and UTPRINT. The DSNUPROC procedure provides the SYSPRINT and UTPRINT DD statements for printed output.

  For a description of data sets that each utility needs, see “Data sets that online utilities use” on page 18.

DSNUPROC uses the parameters that you supply to build an appropriate EXEC statement that executes an online utility.

For an example of executing DSNUPROC, see “Sample DSNUPROC listing” on page 43.

DSNUPROC syntax



DSNUPROC option descriptions

The following list describes all the parameters.

LIB=
Specifies the data set name of the DB2 subsystem library.

The default value is *prefix*.**SSPGM**.

SIZE=
Specifies the region size of the utility execution area; that is, the value represents the number of bytes of virtual storage that are allocated to this utility job.

The default value is **0M**.

SYSTEM=
Specifies the DB2 subsystem or group attachment name or subgroup attachment name.

The default value is **DSN**.

UID=
Specifies the unique identifier for your utility job. The maximum name length is 16 characters. If the name contains special characters, enclose the entire name between apostrophes (for example, 'PETERS.JOB'). Do not reuse the utility ID of a stopped utility that has not yet been terminated. If you do use the same utility ID to invoke a different utility, DB2 tries to restart the original stopped utility with the information that is stored in the SYSUTIL directory table.

The default is an empty string. If you do not specify UID, or you specify UID='', DB2 assigns a utility ID of the form *user-id*.*job-name* to the utility job. *user-id* is the user ID. *job-name* is the job name in the JCL in which DSNUPROC is executed. If the total length of the generated utility ID is longer than 16 bytes, the user ID is truncated to 7 bytes.

UTPROC=
Controls restart processing. The default is an empty string. Use the default if you want to allow DB2 to perform default restart processing; see “Restarting an online utility” on page 52.

To override the default restart behavior, specify one of the following values:

'RESTART'
To restart at the most recent commit point. This option has the same meaning as 'RESTART(CURRENT).'

'RESTART(CURRENT)'
To restart at the most recent commit point. This option has the same meaning as 'RESTART.'

'RESTART(PHASE)'
To restart at the beginning of the phase that executed most recently.

'PREVIEW'
To restart in preview mode. While in preview mode, the utility checks for syntax errors in all utility control statements, but normal utility execution does not take place.

Sample DSNUPROC listing

You can use JCL similar to the following example to invoke DSNUPROC:

```
//DSNUCOP JOB your-job-statement-parameters
//          USER=userid,PASSWORD=password
//*ROUTE PRINT routing-information
//UTIL      EXEC  DSNUPROC,SYSTEM=DSN,UID=TEMP,UTPROC='
//SYSCOPY   DD    DSN=MYCOPIES.DSN8D11A.JAN1,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSIN     DD    *
     COPY TABLESPACE DSN8D11A.DSN8S11D
          FULL NO
          SHRLEVEL CHANGE

/*
```

The preceding JCL job (DSNUCOP) executes the following DSNUPROC procedure:

```
//DSNUPROC PROC LIB='DSN!!0.SDSNLOAD',
//         SYSTEM=DSN,
//         SIZE=0K,UID='',UTPROC=''
//*********************************************************************
//* PROCEDURE-NAME:      DSNUPROC                                     *
//*                                                                   *
//* DESCRIPTIVE-NAME:    UTILITY PROCEDURE                            *
//*                                                                   *
//* FUNCTION:  THIS PROCEDURE INVOKES THE ADMF UTILITIES IN THE       *
//*             BATCH ENVIRONMENT                                     *
//*                                                                   *
//* PROCEDURE-OWNER:     UTILITY COMPONENT                            *
//*                                                                   *
//* COMPONENT-INVOKED:   ADMF UTILITIES (ENTRY POINT DSNUTILB).       *
//*                                                                   *
//* ENVIRONMENT:         BATCH                                        *
//*                                                                   *
//* INPUT:                                                            *
//*      PARAMETERS:                                                  *
//*           LIB    = THE DATA SET NAME OF THE DB2  PROGRAM LIBRARY.  *
//*                    THE DEFAULT LIBRARY NAME IS PREFIX.SDSNLOAD,    *
//*                    WITH PREFIX SET DURING INSTALLATION.           *
//*           SIZE   = THE REGION SIZE OF THE UTILITIES EXECUTION AREA.*
//*                    THE DEFAULT REGION SIZE IS 2048K.              *
//*           SYSTEM = THE SUBSYSTEM NAME USED TO IDENTIFY THIS JOB    *
//*                    TO DB2.  THE DEFAULT IS "DSN".                 *
//*           UID    = THE IDENTIFIER WHICH WILL DEFINE THIS UTILITY   *
//*                    JOB TO DB2.  IF THE PARAMETER IS DEFAULTED OR   *
//*                    SET TO A NULL STRING, THE UTILITY FUNCTION WILL *
```

```
//*                    USE ITS DEFAULT, USERID.JOBNAME.  EACH UTILITY  *
//*                    WHICH HAS STARTED AND IS NOT YET TERMINATED     *
//*                    (MAY NOT BE RUNNING) MUST HAVE A UNIQUE UID.    *
//*           UTPROC = AN OPTIONAL INDICATOR USED TO DETERMINE WHETHER *
//*                    THE USER WANTS TO INITIALLY START THE REQUESTED*
//*                    UTILITY OR TO RESTART A PREVIOUS EXECUTION OF   *
//*                    THE UTILITY.  IF OMITTED, THE UTILITY WILL      *
//*                    BE INITIALLY STARTED.  OTHERWISE, THE UTILITY   *
//*                    WILL BE RESTARTED BY ENTERING THE FOLLOWING     *
//*                    VALUES:                                         *
//*                       RESTART(PHASE)  = RESTART THE UTILITY AT THE *
//*                               BEGINNING OF THE PHASE EXECUTED      *
//*                               LAST.                                *
//*                        RESTART = RESTART THE UTILITY AT THE LAST   *
//*                               OR CURRENT COMMIT POINT.             *
//*                                                                    *
//* OUTPUT: NONE.                                                      *
//*                                                                    *
//* EXTERNAL-REFERENCES: NONE.                                         *
//*                                                                    *
//* CHANGE-ACTIVITY:                                                   *
//*                                                                    *
//*********************************************************************
//DSNUPROC EXEC PGM=DSNUTILB,REGION=&SIZE,
//         PARM='&SYSTEM,&UID,&UTPROC'
//STEPLIB  DD   DSN=&LIB,DISP=SHR
//*********************************************************************
//*                                                                   *
//*  THE FOLLOWING DEFINE THE UTILITIES' PRINT DATA SETS              *
//*                                                                   *
//*********************************************************************
//*
//SYSPRINT DD   SYSOUT=*
//UTPRINT  DD   SYSOUT=*
//SYSUDUMP DD   SYSOUT=*
//*DSNUPROC PEND        REMOVE * FOR USE AS INSTREAM PROCEDURE
```

Figure 5. Sample listing of supplied JCL procedure DSNUPROC

Invoking a DB2 online utility by creating the JCL data set yourself

DB2 online utilities run as standard z/OS jobs. You can either write the JCL for these jobs yourself or use tools to generate some or all of the JCL for you.

About this task

To limit the amount of JCL that you need write, you can use "The supplied JCL procedure (DSNUPROC) for invoking a DB2 online utility" on page 41.

Procedure

To invoke a DB2 online utility by creating the JCL data set yourself:

Include the following JCL statements:

- The JOB statement that is required by your installation standards.
- The JOBLIB or STEPLIB DD statements that are required to access DB2.
- An EXEC statement.

  The EXEC statement can specify a procedure that contains the required JCL, such as DSNUPROC, or it can be of the following form:

```
//stepname  EXEC PGM=DSNUTILB,PARM='system,[uid],[utproc]'
```

The brackets, [ ], indicate optional parameters. The parameters have the following meanings:

DSNUTILB
The utility control program. The program must reside in an APF-authorized library.

system
The DB2 subsystem.

uid
The unique identifier for your utility job.

Do not reuse the utility ID of a stopped utility that has not yet been terminated. If you do use the same utility ID to invoke a different utility, DB2 tries to restart the original stopped utility with the information that is stored in the SYSIBM.SYSUTIL directory table.

utproc
The restart processing behavior. Specify this option only when you want to restart the utility job. You can specify one of the following values:

'RESTART'
Restarts the utility at the most recent commit point. This option has the same meaning as 'RESTART(CURRENT).'

'RESTART(CURRENT)'
Restarts the utility at the most recent commit point. This option has the same meaning as 'RESTART.'

'RESTART(PHASE)'
Restarts the utility at the beginning of the phase that executed most recently.

'RESTART(PREVIEW)'
Restarts the utility in preview mode. While in preview mode, the utility checks for syntax errors in all utility control statements, but normal utility execution does not take place.

Example EXEC statement:

```
//stepname
  EXEC PGM=DSNUTILB,PARM='DSN,TEMP'
```

- Any required DD statements. For information about the DD statements that each utility needs, see “Data sets that online utilities use” on page 18.

Related concepts:

Basic JCL concepts (z/OS Basic Skills)

DSNTIJMV updates to SYS1.PROCLIB (DB2 Installation and Migration)

Related tasks:

Accessing the correct DB2 program library (DB2 Installation and Migration)

Chapter 8. Monitoring and controlling online utilities

You can monitor utilities, run utilities concurrently, terminate utilities, and restart utilities.

Monitoring utilities

You can check the status of any DB2 online utility jobs. You can also check the phase in which the utility is executing or stopped.

About this task

An online utility can have one of the following statuses:

Status	Description
Active	The utility is started.
Stopped	The utility abnormally stopped before completion, but the table spaces and indexes that were accessed by the utility remain under utility control. To make the data available again, take one of the following actions: • Correct the condition that stopped the utility, and restart the utility so that it runs to completion. • Terminate the utility with the DB2 TERM UTILITY command.
Terminated	The DB2 TERM UTILITY command requested that the utility be terminated.

DB2 online utility execution is divided into phases. Each utility starts with the UTILINIT phase, which performs initialization and setup. Each utility finishes with a UTILTERM phase, which cleans up after processing completes. The other phases of online utility execution differ, depending on the utility. For a list of execution phases for each utility, see the documentation for the utility.

Procedure

To monitor utilities:

Use the DB2 DISPLAY UTILITY command. The status and phase is displayed in message DSNU100I, DSNU105I or DSNU106I. (All of these messages are documented under DSNU100I.)

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

Related reference:

-DISPLAY UTILITY (DB2) (DB2 Commands)

-TERM UTILITY (DB2) (DB2 Commands)

Related information:

DSNU100I (DB2 Messages)

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Monitoring processor use by utilities

You can run traces to collect data about the amount of processor time that is used by online utilities.

Procedure

PSPI To monitor processor use by utilities:

Run a trace that writes IFCID 0025 trace records. For a list of trace classes that include IFCID 0025, see Audit trace (DB2 Performance) and Performance trace (DB2 Performance).
The following types of information are collected:

- Whether DFSORT or DB2SORT was invoked.
- The number of parallel data or index sorts that were performed.
- The amounts of time that a utility job used:
  - Total elapsed time
  - Total CPU time
  - Total zIIP time (if an accounting class 1 trace is also activated)
  - CPU time for sorts
  - zIIP time for sorts (if the sort program provided this value)

PSPI

Related concepts:

DB2 trace (DB2 Performance)

Related tasks:

Controlling the DB2 trace (DB2 Administration Guide)

Subsystem parameters for refining DFSMSdss COPY operation with utilities

You can use subsystem parameters to control whether utilities that invoke DFSMSdss COPY use FlashCopy technology.

The following utilities invoke DFDSMSdss COPY:

- CHECK DATA with SHRLEVEL CHANGE
- CHECK INDEX with SHRLEVEL CHANGE
- CHECK LOB with SHRLEVEL CHANGE
- COPY with FLASHCOPY YES or FLASHCOPY CONSISTENT
- LOAD with FLASHCOPY YES or FLASHCOPY CONSISTENT
- REBUILD INDEX with FLASHCOPY YES or FLASHCOPY CONSISTENT
- RECOVER with FLASHCOPY YES or FLASHCOPY CONSISTENT
- REORG INDEX with FLASHCOPY YES or FLASHCOPY CONSISTENT
- REORG TABLESPACE with FLASHCOPY YES or FLASHCOPY CONSISTENT

The following subsystem parameters control whether FlashCopy technology is used:

FLASHCOPY_PPRC
Specifies the behavior for DFSMSdss FlashCopy requests when the target disk storage volume is the primary device in a Peer-to-Peer Remote Copy (Metro Mirror) relationship:

- Whether DFSMSdss preserves mirroring while processing a DB2 utilities request
- Whether the target device pair is allowed to go to duplex pending state

The FLASHCOPY_PPRC parameter applies to the following utilities:

- CHECK DATA
- CHECK INDEX
- CHECK LOB
- COPY
- LOAD
- REBUILD INDEX
- RECOVER
- REORG INDEX
- REORG TABLESPACE

CHECK_FASTREPLICATION
Specifies whether the CHECK utilities direct DFSMSdss COPY to use FlashCopy as the preferred method for copying objects to shadow data sets, or as the only method for copying objects to shadow data sets.

COPY_FASTREPLICATION
Specifies whether the COPY utility directs DFSMSdss COPY to use FlashCopy as the preferred method for copying objects to shadow data sets, as the only method for copying objects to shadow data sets, or not at all.

REC_FASTREPLICATION
Specifies how the RECOVER utility directs DFSMSdss COPY to restore an image copy that was created with FlashCopy. REC_FASTREPLICATION directs DFSMSdss COPY to use FlashCopy as the preferred method, as the only method, or not to use FlashCopy.

The parameters that DFSMSdss COPY specifies for the CHECK utilities depend on the combination of values for FLASHCOPY_PPRC and CHECK_FASTREPLICATION that you specify, as shown in the following table.

Table 6. FLASHCOPY_PPRC and CHECK_FASTREPLICATION values and resulting DFSMSdss COPY parameter values for CHECK utilities

FLASHCOPY_PPRC value	CHECK_FASTREPLICATION value	
	PREFERRED	**REQUIRED**
blank	FASTREP(PREF)	FASTREP(REQ)
NONE	FASTREP(PREF)	FASTREP(REQ)
	FCTOPPRCP(PresMirNone)	FCTOPPRCP(PresMirNone)
PREFERRED	FASTREP(PREF)	FASTREP(REQ)
	FCTOPPRCP(PresMirPref)	FCTOPPRCP(PresMirPref)
REQUIRED	FASTREP(PREF)	FASTREP(REQ)
	FCTOPPRCP(PresMirReq)	FCTOPPRCP(PresMirReq)

The parameters that DFSMSdss COPY specifies for the RECOVER utility depend on the combination of values for FLASHCOPY_PPRC and REC_FASTREPLICATION that you specify, as shown in the following table.

Table 7. FLASHCOPY_PPRC and REC_FASTREPLICATION values and resulting DFSMSdss COPY parameter values for the RECOVER utilityFLASHCOPY_PPRC and REC_FASTREPLICATION values and resulting DFSMSdss COPY parameter values for the RECOVER utility

FLASHCOPY_PPRC value	REC_FASTREPLICATION		
	NONE	**PREFERRED**	**REQUIRED**
blank	FASTREP(NONE)	FASTREP(PREF)	FASTREP(REQ)
NONE	FASTREP(NONE)	FASTREP(PREF)	FASTREP(REQ)
		FCTOPPRCP(PresMirNone)	FCTOPPRCP(PresMirNone)
PREFERRED	FASTREP(NONE)	FASTREP(PREF)	FASTREP(REQ)
		FCTOPPRCP(PresMirPref)	FCTOPPRCP(PresMirPref)
REQUIRED	FASTREP(NONE)	FASTREP(PREF)	FASTREP(REQ)
		FCTOPPRCP(PresMirReq)	FCTOPPRCP(PresMirReq)

Related concepts:

"FlashCopy image copies" on page 163

Related reference:

FAST REPLICATION field (CHECK_FASTREPLICATION subsystem parameter) (DB2 Installation and Migration)

FLASHCOPY PPRC field (FLASHCOPY_PPRC subsystem parameter) (DB2 Installation and Migration)

FAST RESTORE field (REC_FASTREPLICATION subsystem parameter) (DB2 Installation and Migration)

Determining why a utility failed to complete

If an online utility job completes normally, it issues return code 0. If it completes with warning messages, it issues return code 4. Return code 8 means that the job failed to complete. Return code 12 means that an authorization error occurred.

Procedure

To determine why a utility failed to complete:

Use the following list of possible scenarios to help resolve the problem:

Problem	Solution
DB2 terminates the utility job step and any subsequent utility steps.	Submit a new utility job to execute the terminated steps. Use the same utility identifier for the new job to ensure that no duplicate utility job is running.
DB2 does not execute the particular utility function, but prior utility functions are executed.	Submit a new utility step to execute the function.

Problem	Solution
DB2 places the utility function in the stopped state.	Restart the utility job step at either the last commit point or the beginning of the phase by using the same utility identifier. Alternatively, use the TERM UTILITY command to terminate the job step and then resubmit it. **Related information:** "Restarting an online utility" on page 52 "Terminating an online utility"
DB2 terminates the utility and issues return code 8.	One or more objects might be in a restrictive or advisory state. Resolve that status and resubmit the job. Also, a DEADLINE condition in REORG might have terminated the reorganization. **Related information:** Appendix C, "Advisory or restrictive states," on page 1103 "Syntax and options of the REORG INDEX control statement" on page 514 "Syntax and options of the REORG TABLESPACE control statement" on page 555

Terminating an online utility

You can terminate the execution of an active utility or release the resources that are associated with a stopped utility.

About this task

GUPI

After you terminate a utility, you cannot restart the terminated utility job. The objects on which the utility was operating might be left in an indeterminate state. In many cases, you cannot rerun the same utility without first recovering the objects on which the utility was operating. The situation varies, depending on the utility and the phase that was in process when you issued the command. These considerations about the state of the object are particularly important when you terminate the COPY, LOAD, and REORG utilities.

Procedure

To terminate an online utility:

Issue the **TERM UTILITY** command. If the utility was started in a previous release of DB2, issue the **TERM UTILITY** command from that release.
In a data sharing environment, the following rules apply:

- For active utilities, issue the command from the DB2 subsystem on which the utility was started. If a DB2 subsystem fails while a utility is in progress, you must restart that DB2 subsystem, and then you can terminate the utility from any system.

- For stopped utilities, you can terminate them from any active member of the data sharing group.
- In a data sharing coexistence environment, you can terminate a utility only on the same release in which the utility was started.

If the utility is active, DB2 terminates the execution of the utility at the next commit point and then performs any necessary cleanup operations. If the utility is stopped, DB2 releases the resources that are associated with the stopped utility.

Example of conditionally terminating a utility

You might choose to put the **TERM UTILITY** command in a conditionally executed job step; for example, if you never want to restart certain utility jobs. The following figure shows such an example.

```
//TERM EXEC PGM=IKJEFT01,COND=((8,GT,S1),EVEN)
//*
//*************************************************************
//* IF THE PREVIOUS UTILITY STEP, S1, ABENDS, ISSUE A
//* TERMINATE COMMAND.  IT CANNOT BE RESTARTED.
//*************************************************************
//*
//SYSPRINT DD  SYSOUT=A
//SYSTSPRT DD  SYSOUT=A
//SYSOUT   DD  SYSOUT=A
//SYSUDUMP DD  SYSOUT=A
//SYSTSIN  DD  *
DSN SYSTEM(DSN)
-TERM UTILITY(TEMP)
END
/*
```

Figure 6. Example of conditionally executed TERM UTILITY

Alternatively, consider specifying the TIMEOUT TERM parameter for some online REORG situations. GUPI

Related reference:

-TERM UTILITY (DB2) (DB2 Commands)

"Syntax and options of the REORG INDEX control statement" on page 514

"Syntax and options of the REORG TABLESPACE control statement" on page 555

Restarting an online utility

If a utility finishes abnormally, you might be able to restart it. You need only resubmit the job and DB2 attempts to restart it. However, you might need or choose to make other changes before you resubmit the job.

About this task

Utilities can be restarted with one of the following two methods:

Phase restart
The utility restarts from the beginning of the phase that was being processed. This method is indicated by the parameter RESTART(PHASE).

Current restart
The utility restarts from the last checkpoint that was taken during the execution of the utility phase. If the utility phase does not take any

checkpoints or has not reached the first checkpoint, current restart is equivalent to phase restart. This method is indicated by the parameter RESTART or RESTART(CURRENT).

Restarting a utility job is not always possible. If you cannot restart a utility job, you might have to terminate it to make the data available to other applications. To terminate a utility job, issue the DB2 **TERM UTILITY** command. Use this command only if you must start the utility from the beginning.

Procedure

To restart an online utility:

1. Correct the problem that caused the utility job to stop.
2. If needed, make changes to the utility job. Use the following guidelines:
   - Do not specify z/OS automatic step restart.
   - Ensure that the required data sets are properly defined.

     Recommendation: Allocate the data sets by using TEMPLATE statements that do not specify the DISP and SPACE parameter values. When these parameters are not specified, DB2 determines the correct disposition and size of these data sets.
   - Check the DISP parameters on the DD statements. For example, for DD statements that have DISP=NEW and need to be reused, change DISP to OLD or MOD. If generation data groups (GDGs) are used and any (+1) generations were cataloged, ensure that the JCL is changed to GDG (+0) for such data sets.

     Automatically generated JCL normally has DISP=MOD. DISP=MOD allows a data set to be allocated during the first execution and then reused during a restart.

     When restarting a job that involves templates, DB2 automatically changes the disposition from NEW to MOD. Therefore, you do not need to change template specifications for restart.
   - For any data sets that are not dynamically allocated, ensure that the DD name that is specified in the restart JCL matches the DD name for the original job. Do not change DD names on a restart job.

     If the LOAD utility is restarted with a different SYSREC data set from the SYSREC data set for the initial invocation, the data control block (DCB) parameters must be the same as the SYSREC DCB parameters for the initial invocation. RESTART(PHASE) is recommended. RESTART(CURRENT) might have unpredictable results because data set checkpoint information is not used during restart processing.
   - For any data sets that are dynamically allocated, ensure that the file sequence numbers in the restart job match those file sequence numbers in the original job.
   - For data sets that are not cataloged, ensure that any explicit VOLSER specifications in the restart job match those specifications in the original job. If you copy a work data set, such as SYSUT1, after abend B37, and the number of volumes changes, do not specify RESTART(CURRENT). If you do, abend 413-1C occurs. To prevent this abend, start the utility in RESTART(PHASE).
   - For any cataloged data sets, do not specify VOLSER. Let DB2 determine the VOLSER value of the data sets from the system catalog.

- Include all of the original utility statements and do not change the position of any other utility statements that have executed. During restart processing, DB2 remembers the relative position of the stopped utility statement in the input stream. The exception is DIAGNOSE statements. You can add or delete DIAGNOSE statements as needed.
- Do not change the utility function that is stopped and the DB2 objects on which it is operating. However, you can change other parameters that are related to the stopped step and to subsequent utility steps.
- Do not change any EXEC SQL or OPTIONS utility control statements that executed before the stopped utility, if possible. If you must change these utility control statements, use caution; any changes can cause the restart processing to fail. For example, if you specify a valid OPTIONS statement in the initial invocation, and then on restart, specify OPTIONS PREVIEW, the restart fails.
- Use caution if you change LISTDEF lists before you restart the utility. When DB2 restarts list processing, it uses a saved copy of the list. Modifying the LISTDEF list that is referenced by the stopped utility has no effect. Only control statements that follow the stopped utility are affected. See "How utilities restart with lists" on page 58.
- Use caution if you change TEMPLATE statements before restarting the utility. See "How utilities restart with templates" on page 57.
- If you are using the DSNUTILS stored procedure, specify NONE or ANY for the *utility-name* parameter. These values suppress the dynamic allocation that is normally performed by DSNUTILS. You can then specify TEMPLATE statements (in the *utstmt* parameter) to allocate the necessary data sets.

3. Resubmit the job with the same utility ID and optionally specify a RESTART parameter value.

   DB2 recognizes the utility ID and restarts the utility job if possible. DB2 retrieves information about the stopped utility from the SYSIBM.SYSUTIL directory table.

   For each utility, DB2 uses the default RESTART value that is specified in the following table.

Table 8. Default RESTART values for each utility

Utility	Default RESTART value	Description of restart behavior and restrictions
BACKUP SYSTEM	RESTART(CURRENT)	"Termination or restart of BACKUP SYSTEM" on page 66
CATENFM	No restart	NA
CATMAINT	No restart	NA
CHECK DATA	RESTART(CURRENT)	"Termination and restart of CHECK DATA" on page 104
CHECK INDEX	RESTART(CURRENT)	"Termination or restart of CHECK INDEX" on page 124
CHECK LOB	RESTART(CURRENT)	"Termination or restart of CHECK LOB" on page 136
COPY	RESTART(CURRENT)	"Restart of COPY" on page 178
COPYTOCOPY	RESTART(CURRENT)	"Termination or restart of COPYTOCOPY" on page 204

Table 8. Default RESTART values for each utility (continued)

Utility	Default RESTART value	Description of restart behavior and restrictions
DIAGNOSE	Restarts from the beginning	"Termination or restart of DIAGNOSE" on page 214
EXEC SQL	Restarts from the beginning	"Termination or restart of EXEC SQL" on page 219
LISTDEF	Restarts from the beginning	"Termination or restart of LISTDEF" on page 240
LOAD	RESTART(CURRENT) or RESTART(PHASE)[a]	"Restart of LOAD" on page 350
MERGECOPY	RESTART(PHASE)	"Termination or restart of MERGECOPY" on page 381
MODIFY RECOVERY	RESTART(CURRENT)	"Termination or restart of MODIFY RECOVERY" on page 394
MODIFY STATISTICS	RESTART(CURRENT)	"Termination or restart of MODIFY STATISTICS" on page 403
OPTIONS	Restarts from the beginning	"Termination or restart of OPTIONS" on page 412
QUIESCE	RESTART(CURRENT)	"Termination and restart of QUIESCE" on page 423
REBUILD INDEX	RESTART(PHASE)	"Termination or restart of REBUILD INDEX" on page 453
RECOVER	RESTART(CURRENT)	"Termination or restart of RECOVER" on page 507
REORG INDEX	RESTART(CURRENT) or RESTART(PHASE)[a]	"Restart of REORG INDEX" on page 545
REORG TABLESPACE	RESTART(CURRENT) or RESTART(PHASE)[a]	"Restart of REORG TABLESPACE" on page 644
REPAIR	No restart	NA
REPORT	RESTART(CURRENT)	"Termination or restart of REPORT" on page 700
RESTORE SYSTEM	RESTART(CURRENT)	"Termination and restart of RESTORE SYSTEM" on page 733
RUNSTATS	RESTART(CURRENT)	"Termination or restart of RUNSTATS" on page 770
STOSPACE	RESTART(CURRENT)	"Termination or restart of STOSPACE" on page 787
TEMPLATE	Restarts from the beginning	"Termination or restart of TEMPLATE" on page 811
UNLOAD	RESTART(CURRENT)	"Termination or restart of UNLOAD" on page 877

Note:

1. The RESTART value that DB2 uses for these utilities depends on the situation. For a complete explanation for each utility, see the information in the third column.

You can override the default RESTART value by specifying the RESTART parameter in the original JCL data set. See "Overriding the default utility restart behavior by using the RESTART parameter."

If a utility is restarted in the UTILINIT phase, it is re-executed from the beginning of the phase.

Data sharing: You can restart a utility only on a member that is running the same DB2 release level as the member on which the utility job was originally submitted. The same utility ID (UID) must be used to restart the utility. That UID is unique within a data sharing group. However, if DB2 fails, you must restart DB2 on either the same or another z/OS system before you restart the utility.

What to do next

If you restarted a LOAD, REBUILD INDEX, or REORG job with the STATISTICS option, run the RUNSTATS utility after the restarted job completes. When you restart these jobs, DB2 does not collect inline statistics. The exception is REORG UNLOAD PAUSE; when restarted after the pause, REORG UNLOAD PAUSE collects statistics.

Related tasks:

"Terminating an online utility" on page 51

Related information:

Automatic Step Restart (DFSMSdfp Checkpoint/Restart)

Overriding the default utility restart behavior by using the RESTART parameter

You do not need to use the RESTART parameter to restart a utility job.

When you resubmit a job that finished abnormally and has not been terminated, DB2 recognizes the utility ID from the SYSIBM.SYSUTIL directory table and restarts the utility job if possible. However, if you want to override the default RESTART value, you can update the original JCL data set by adding the RESTART parameter. Any RESTART values that you specify always override the default values. DB2 ignores the RESTART parameter if you are submitting the utility job for the first time.

Procedure

To override the default utility restart behavior, add the RESTART parameter by using one of the following methods:

- If you invoke the utility by using DB2I, specify the RESTART value on a DB2I panel:
  1. Access the DB2 Utilities panel.
  2. Complete the panel fields.
  3. Change field 5 (**RESTART**) to `CURRENT` or `PHASE`, depending on the restart method that you want.
  4. Press **Enter**.

  For information about the DB2 Utilities panel fields, see "Invoking an online utility by using the DB2 Utilities panel in DB2I" on page 29

- If you invoke the utility by using the DSNU CLIST command, change the value of the RESTART parameter on the command. See "DSNU CLIST command syntax" on page 36.
- If you created your own JCL to invoke the utility, specify RESTART (CURRENT) or RESTART(PHASE) on the EXEC statement. For information about the RESTART parameter, see "Invoking a DB2 online utility by creating the JCL data set yourself" on page 44.

Restarting a utility after the output data set is full

If a utility job terminates with an out-of-space condition on the output data set, you might need to restart the job at the last commit point.

Procedure

To restart a utility after the output data set is full:

1. Copy the output data set to a temporary data set. Use the same data control block (DCB) parameters. Use z/OS utilities that do not reblock the data set during the copy operation (for example, DFSMSdss ADRDSSU or DFSORT ICEGENER). Avoid using the IEBGENER or ISPF 3.3 utilities.
2. Delete or rename the output data set. Ensure that you know the current DCB parameters.
3. Redefine the output data set with additional space. Use the same VOLSER (if the data set is not cataloged), the same DSNAME, and the same DCB parameters.
4. Copy the data from the temporary data set into the new, larger output data set. Use z/OS utilities that do not reblock the data set during the copy operation (for example, DFSMSdss ADRDSSU or DFSORT ICEGENER).
5. Restart the online utility

Related concepts:

Examples of Data Set Copy Operations (z/OS DFSMSdss Storage Administration)

Related reference:

DCB Subparameters (MVS JCL Reference)

Related information:

ICEGENER (DFSORT Tuning Guide)

How utilities restart with templates

Unlike most other utility control statements, TEMPLATE utility control statements can be modified before you restart a utility. In some cases, they must be modified to correct a prior failure.

If possible, do not change the TEMPLATE control statement. If you must change it, use caution. In some cases, modifications can cause restart processing to fail. For example, if you change the template name of a temporary work data set that was opened in an earlier phase and closed but is to be used later, restart processing fails.

Restriction: When a TEMPLATE utility control statement includes the PATH keyword, the utility that uses that template cannot be restarted.

When a utility is restarted, template allocation automatically adjusts data set dispositions to reallocate the data sets from the prior execution. You do not need to change the TEMPLATE DISP option. DB2 also takes checkpoints for the values that are used for TEMPLATE DSN variables, and the old values are reused when the utility is restarted.

If the failure of the utility job was due to space problems on a data set, the same restart considerations apply as if DD statements were used.

If the failure of the utility job was due to insufficient space on a volume, you can alter the TEMPLATE statement. How the TEMPLATE statement needs to be altered depends on whether the SPACE keyword was specified. If SPACE was specified, specify a different volume or alter the primary and secondary space quantities. If SPACE was not specified, specify a different volume or add the PCTPRIME and NBRSECND options. Lower the value of the PCTPRIME option to decrease the size of the primary allocation, and increase the value of the NBRSECND option to decrease the size of the secondary allocation.

Related tasks:

"Restarting a utility after the output data set is full" on page 57

Related reference:

Chapter 35, "TEMPLATE," on page 789

How utilities restart with lists

Lists are defined by the LISTDEF utility. Unlike other utility control statements, LISTDEF control statements can be modified before you restart a utility. However, those changes do not affect the currently running utility. The changed list affects only those utility control statements that follow the stopped utility.

When you originally submit a utility control statement that references a list, DB2 expands the contents of the list and saves the list before executing the utility. DB2 uses this saved list to restart the utility at the point of failure. After LISTDEF repositions in the list at the point of failure, individual utility restart processing is invoked. This restart behavior varies by utility. After the utility is successfully restarted, the LISTDEF list is re-expanded before it is used by subsequent utilities in the same job step.

To determine whether the utility that you are restarting is processing a list or the size of the list that the utility is processing, issue the DISPLAY UTILITY command. If a list is being used, the size is reported in message DSNU100 or DSNU105 in the DISPLAY UTILITY output.

Related reference:

Chapter 19, "LISTDEF," on page 221

-DISPLAY UTILITY (DB2) (DB2 Commands)

Related information:

DSNU100I (DB2 Messages)

Chapter 9. BACKUP SYSTEM

The online BACKUP SYSTEM utility invokes z/OS DFSMShsm (Version 1 Release 7 or above) to copy the volumes on which the DB2 data and log information resides. These system-level backups can be taken for either a DB2 subsystem or data sharing group. You can later run the RESTORE SYSTEM utility to recover the subsystem or data sharing group.

You can use BACKUP SYSTEM to copy all data for a single application (for example, when DB2 is the database server for a resource planning solution).

Restrictions:

- All data sets that you want to copy must be SMS-managed data sets.
- A data sharing environment, no failed abnormally quiesced members can exist. Otherwise, the BACKUP SYSTEM request fails.
- If you want to manage the dumping of system-level backups to tape, you need to have z/OS DFSMShsm V1R8 or above.

The BACKUP SYSTEM utility uses copy pools. You must define these copy pools before you run BACKUP SYSTEM. See "Copy pools" on page 63.

Output

The output for BACKUP SYSTEM is the copy of the volumes on which the DB2 data and log information resides. The copies are called *system-level backups*.

The BACKUP SYSTEM history is recorded in the bootstrap data sets (BSDSs).

BACKUP SYSTEM does not reset COPY-pending status. To remove COPY-pending status, take an image copy of the affected object.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with nonzero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains nonzero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Related information:

"COPY-pending status" on page 1106

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Authorization required

To execute this utility, you must use a privilege set that includes SYSCTRL or SYSADM authority.

Execution phases of BACKUP SYSTEM

The BACKUP SYSTEM utility operates in these phases:

Phase Description

UTILINIT
Performs initialization and setup.

COPY Copies data.

UTILTERM
Performs cleanup.

Related concepts:

Point-in-time recovery with system-level backups (DB2 Administration Guide)

Related reference:

Chapter 32, "RESTORE SYSTEM," on page 727

Syntax and options of the BACKUP SYSTEM control statement

The BACKUP SYSTEM utility control statement, with its multiple options, defines the function that the utility job performs.

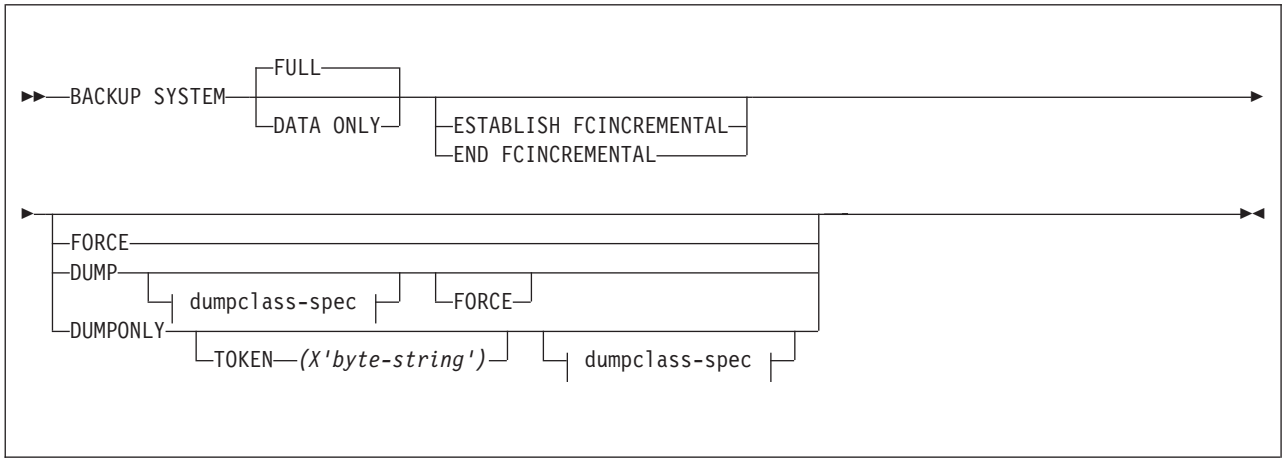
Use the ISPF/PDF edit function to create a control statement and to save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

When you specify BACKUP SYSTEM, you can specify only the following statements in the same step:

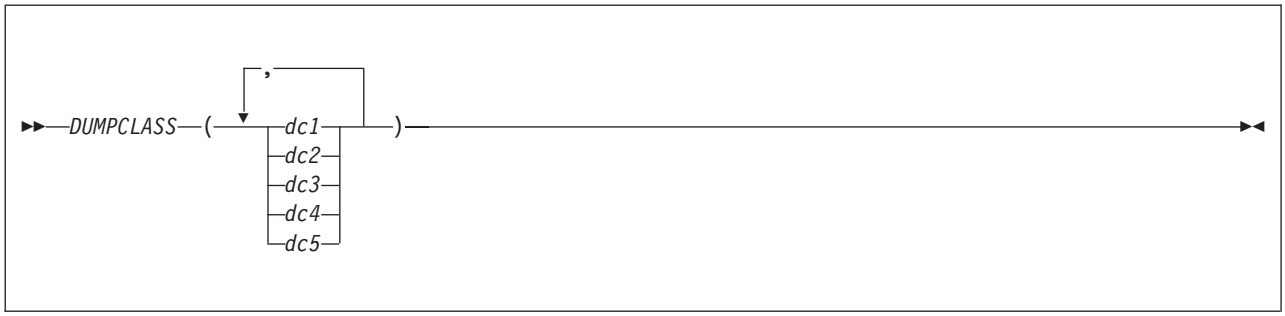
- DIAGNOSE
- OPTIONS PREVIEW
- OPTIONS OFF
- OPTIONS KEY
- OPTIONS EVENT WARNING

In addition, BACKUP SYSTEM must be the last statement in SYSIN.

Syntax diagram



dumpclass-spec:



Option descriptions

FULL
Indicates that you want to copy both the database copy pool and the log copy pool.

You must ensure that the database copy pool is set up to contain the volumes for the databases and the associated integrated catalog facility (ICF) catalogs. You must also ensure that the log copy pool is set up to contain the volumes for the BSDSs, the active logs, and the associated catalogs.

Use BACKUP SYSTEM FULL to allow for recovery of both data and logs. You can use the RESTORE SYSTEM utility to recover the data. However, RESTORE SYSTEM does not restore the logs; the utility only applies the logs. If you want to restore the logs, you must use another method to restore them.

DATA ONLY
Indicates that you want to copy only the database copy pool. You must ensure that the database copy pool is set up to contain the volumes for the databases and the associated ICF catalogs.

ESTABLISH FCINCREMENTAL
Specifies that a persistent incremental FlashCopy relationship is to be established, if none exists, for source copy volumes in the database copy pool. Use this keyword once to establish the persistent incremental FlashCopy

relationships. Subsequent invocations of BACKUP SYSTEM (without this keyword) automatically process the persistent incremental FlashCopy relationship.

END FCINCREMENTAL
Specifies that a last incremental FlashCopy is to be taken and that the persistent incremental FlashCopy relationship is to be withdrawn for all of the volumes in the database copy pool. Use this keyword only if you do not want further incremental FlashCopy backups of the database copy pool.

FORCE
Indicates that you want to overwrite the oldest DFSMShsm version of the fast replication copy of the database copy pool. You can overwrite these copy pools even if the dump to tape or the copy pool's DFSMShsm dump classes were initiated, but are only partially completed.

Use the FORCE option only if it is more important to take a new system-level backup than to save a previous system-level backup to tape.

DUMP
Indicates that you want to create a fast replication copy of the database copy pool and the log copy pool on disk and then initiate a dump to tape of the fast replication copy. The dump to tape begins after DB2 successfully establishes relationships for the fast replication copy.

The BACKUP SYSTEM utility does not wait for the dump processing to complete.

This option requires z/OS Version 1.8.

DUMPCLASS
Indicates the DFSMShsm dump class that you want to use for the dump processing. You can specify up to five dump classes. If you do not specify a dump class, DB2 uses the default dump classes that are defined for the copy pools.

DUMPONLY
Indicates that you want to create a dump on tape of an existing fast replication copy (that resides on the disk) of the database copy pool and the log copy pool. You can also use this option to resume a dump process that failed.

The BACKUP SYSTEM utility does not wait for the dump processing to complete.

This option requires z/OS Version 1.8.

TOKEN *(X'byte-string')*
Specifies which fast replication copy of the database copy pool and the log copy pool to dump to tape.

The token is a 36 digit or 44-digit hexadecimal byte string that uniquely identifies each system-level backup and is reported in the DSNJU0004 job output. For a data sharing system, run DSNJU0004 with the MEMBER option so that the system-level backup information is displayed for all members. Backups that are taken before the BSDS is converted to 10-byte extended format are identified with 36-digit tokens. Backups that are taken after the BSDS is converted to 10-byte extended format are identified with 44-digit tokens. If specified, the token must be in the correct format for the system-level backup.

If you do not specify TOKEN, the most recent fast replication copy of the copy pools is dumped to tape.

Before running BACKUP SYSTEM

Certain activities might be required before you run the BACKUP SYSTEM utility, depending on your situation.

To run BACKUP SYSTEM, ensure that the following conditions are true:

- The data sets that you want to copy are SMS-managed data sets.
- You are running z/OS V1R7 or above.
- You are running z/OS V1R8 or above if both of the following conditions are true:
  - You want to use the DUMP, DUMPONLY, or FORCE options.
  - You want the RECOVER utility to be able to use system-level backups for object-level recoveries.
- You have disk control units that support ESS FlashCopy.
- Any needed copy pools are defined. See "Copy pools."
- The ICF catalog for the data must be on a separate volume than the ICF catalog for the logs.
- An SMS backup storage group is defined for each storage group in the copy pools.

Related information:

Defining Copy Pools (DFSMSdfp Storage Administration)

Defining Storage Group Attributes (DFSMSdfp Storage Administration)

Altering copy pools (DFSMSdfp Storage Administration)

Copy pools

The BACKUP SYSTEM utility uses copy pools. A *copy pool* is a defined set of storage groups that contain data that DFSMShsm can back up and recover collectively. Each of these storage groups contains the name of the associated backup storage group for storing the backup.

Each DB2 subsystem can have up to two copy pools, one for databases and one for logs. BACKUP SYSTEM copies the volumes that are associated with these copy pools at the time of the copy.

You must define any needed copy pools before you run BACKUP SYSTEM. You must at least define a database copy pool, and that definition must include the ICF catalog names. (You can add the ICF catalog names to the database copy pool definition by altering the copy pools.) If you plan to also copy the logs, define another copy pool for your logs.

Use the following DB2 naming convention when you define the required copy pools:

```
DSN$locn-name$cp-type
```

where:

DSN The unique DB2 product identifier.

**$** A delimiter. You must use the dollar sign character ($).

locn-name
The DB2 location name.

cp-type The copy pool type. Use DB for database and LG for log.

Related information:

Defining Copy Pools (DFSMSdfp Storage Administration)

Defining Storage Group Attributes (DFSMSdfp Storage Administration)

Data sets that BACKUP SYSTEM uses

The BACKUP SYSTEM utility uses a number of data sets during its operation.

The following table lists the data sets that the BACKUP SYSTEM utility uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set

Table 9. Data sets that BACKUP SYSTEM uses

Data sets	Description	Required?
SYSIN	An input data set that contains the utility control statement	Yes
SYSPRINT	An output data set for messages	Yes

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for BACKUP SYSTEM

The BACKUP SYSTEM utility has certain concurrency and compatibility characteristics associated with it.

The BACKUP SYSTEM utility can run concurrently with any other utility; however, it must wait for the following DB2 events to complete before the copy can begin:

- Extending of data sets
- Writing of 32-KB pages
- Writing close page set control log records (PSCRs)
- Creating data sets (for table spaces, indexes, and so forth)
- Deleting data sets (for dropping tables spaces, indexes, and so forth)
- Renaming data sets (for online reorganizing of table spaces, indexes, and so forth during the SWITCH phase)

Only one BACKUP SYSTEM job can be running at one time.

BACKUP SYSTEM cannot run concurrently with utilities that use FlashCopy to create data sets in the database copy pool. For example, suppose that CHECK INDEX SHRLEVEL CHANGE does a FlashCopy from a source object to a shadow data set. The disk volume where the shadow data set resides becomes the target in a FlashCopy relationship. If this disk volume is in the database copy pool, BACKUP SYSTEM cannot copy it.

For the CHECK INDEX, CHECK DATA, and CHECK LOB utilities, you can use subsystem parameter UTIL_TEMP_STORCLAS to specify an alternative storage class that contains volumes that are not in the database copy pool. When UTIL_TEMP_STORCLAS is specified, the CHECK utilities use the alternative

storage class to create the shadow data sets. Therefore, volumes that are targets in a FlashCopy relationship after the CHECK utilities run are not in the database copy pool.

Dumping a fast replication copy to tape

With the BACKUP SYSTEM online utility, you can dump a fast replication copy of a system-level backup to tape. You can then manage the available disk space, retain the system-level backups, and provide a means of recovery after a media failure.

Procedure

To dump a fast replication copy of a system-level backup to tape that was taken without the DUMP option, or to re-initiate dump processing that has failed:

1. Identify the token (a 36 digit or 44 digit hexadecimal byte string) in the DSNJU004 output.
2. Create and run your utility control statement with the DUMPONLY option. Specify the token if the system-level backup is not the most recent system-level backup taken.

   Restriction: Do not dump system-backups to the same tape that contains image copies or concurrent copies because the RECOVER utility requires access to both
3. Run the DFSMShsm command LIST COPYPOOL with the ALLVOLS option to verify that the dump to tape was successful. The BACKUP SYSTEM utility issues the DFSMShsm command to initiate a dump, but it does not wait for the dump to be completed.

Backups of log copy pools

If you take backups of both the log and database copy pool, you can use the backups to restore the log copy pool.

When you use backups to restore the log copy pool, if the active log data sets are stripped, or if the log copy pool is for a data sharing environment, you must specify the data complete LRSN during the conditional restart in the following scenarios:

- You are cloning a DB2 system by using a system-level backup as the source. In this case, conditionally restart DB2 with an ENDRBA or ENDLRSN that is equal to the data complete LRSN of the system-level backup.
- You are performing a system-level point-in-time recovery. In this case, conditionally restart DB2 with the log truncation point equal to or less than the data complete LRSN of the system-level backup. Use the data complete LRSN as the CRESTART ENDRBA, ENDLRSN, or SYSPITR log truncation point.

You can determine the data complete LRSN from the following places:

- Message DSNU1614I, which is generated when BACKUP SYSTEM completes successfully
- The report generated by the print log map utility (DSNJU004)

Related concepts:

"Before running RESTORE SYSTEM" on page 730

Conditional restart with system-level backups (DB2 Administration Guide)

Related reference:

Chapter 42, "DSNJU004 (print log map)," on page 923

Related information:

DSNU1614I (DB2 Messages)

Termination or restart of BACKUP SYSTEM

You can terminate BACKUP SYSTEM by using the TERM UTILITY command. BACKUP SYSTEM checks for the TERM UTILITY command before the call to copy data. TERM UTILITY deletes the copy that is being created through the BACKUP SYSTEM utility.

To use TERM UTILITY to terminate BACKUP SYSTEM on a data sharing group, you must issue the command from the member on which the BACKUP SYSTEM utility is invoked.

You can restart a BACKUP SYSTEM utility job, but it starts from the beginning again.

Sample BACKUP SYSTEM control statements

Use sample control statements as models for developing your own BACKUP SYSTEM utility control statements.

Example 1: Creating a full backup of a DB2 subsystem or data sharing group

The following control statement specifies that the BACKUP SYSTEM utility is to create a full backup copy of a DB2 subsystem or data sharing group. The full backup includes copies of both the database copy pool and the log copy pool. In this control statement, the FULL option is not explicitly specified, because it is the default.

```
//STEP1    EXEC DSNUPROC,TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
  BACKUP  SYSTEM
/*
```

Example 2: Creating a data-only backup of a DB2 subsystem or data sharing group

The following control statement specifies that BACKUP SYSTEM is to create a backup copy of only the database copy pool for a DB2 subsystem or data sharing group.

```
//STEP1    EXEC DSNUPROC,TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
  BACKUP  SYSTEM  DATA ONLY
/*
```

Example 3: Creating a fast replication copy of the database copy pool and dumping the copy to tape

The following control statement specifies that BACKUP SYSTEM is to create a fast replication copy of the database copy pool and initiate a dump to tape of the fast replication copy.

```
//SYSOPRB JOB (ACCOUNT),'NAME',CLASS=K
//UTIL EXEC DSNUPROC,SYSTEM=V91A,UID='TEMB',UTPROC=''
//*
//*
//DSNUPROC.SYSUT1 DD DSN=SYSOPR.SYSUT1,
//     DISP=(MOD,DELETE,CATLG),
//     SPACE=(16384,(20,20),,,ROUND),
//     UNIT=SYSDA
//DSNUPROC.SYSIN    DD  *
   BACKUP  SYSTEM DATA ONLY DUMP
/*
```

Example 4: Creating a fast replication copy of the database copy pool, dumping the copy to tape, and allowing oldest copy to be overwritten

The following control statement specifies that BACKUP SYSTEM is to perform the following actions:

- Create a fast replication copy of the database copy pool
- Initiate a dump to tape of the fast replication copy
- Allow the oldest fast replication copy to be overwritten

```
//SYSOPRB JOB (ACCOUNT),'NAME',CLASS=K
//UTIL EXEC DSNUPROC,SYSTEM=V91A,UID='TEMB',UTPROC=''
//*
//*
//DSNUPROC.SYSUT1 DD DSN=SYSOPR.SYSUT1,
//     DISP=(MOD,DELETE,CATLG),
//     SPACE=(16384,(20,20),,,ROUND),
//     UNIT=SYSDA
//DSNUPROC.SYSIN    DD  *
    BACKUP  SYSTEM DATA ONLY DUMP FORCE
/*
```

Example 5: Dumping an existing fast replication copy to tape

The following control statement specifies that BACKUP SYSTEM is to dump the existing fast replication copy X'E5F9F1C1BD1909683AA8A1A600000E6962DE' to tape, using the DB2STGD2 dump class.

```
//SYSOPRB JOB (ACCOUNT),'NAME',CLASS=K
//UTIL EXEC DSNUPROC,SYSTEM=V91A,UID='TEMB',UTPROC=''
//*
//*
//DSNUPROC.SYSUT1 DD DSN=SYSOPR.SYSUT1,
//     DISP=(MOD,DELETE,CATLG),
//     SPACE=(16384,(20,20),,,ROUND),
//     UNIT=SYSDA
//DSNUPROC.SYSIN    DD  *
      BACKUP  SYSTEM DATA ONLY DUMPONLY
        TOKEN (X'E5F9F1C1BD1909683AA8A1A600000E6962DE')
          DUMPCLASS(DB2STGD2)
/*
```

Chapter 10. CATENFM

The CATENFM online utility enables a DB2 subsystem to enter DB2 Version 11 enabling-new-function mode and Version 11 new-function mode. It also enables a DB2 subsystem to return to enabling-new-function mode from new-function mode.

All new Version 11 functions are unavailable when the subsystem is in conversion mode or enabling-new-function mode.

Output

Output from the CATENFM utility consists of:

- If you specify the CONVERT option, the CATENFM utility converts table spaces during the enabling-new-function mode process.
- If you specify the ALTER option, some objects in the DB2 catalog are altered or created.
- For other options, there is no output.

Authorization required

The required authorization for CATENFM is installation SYSADM.

Execution phases of CATENFM

The CATENFM utility operates in these phases:

Phase Description

UTILINIT
Performs initialization and setup

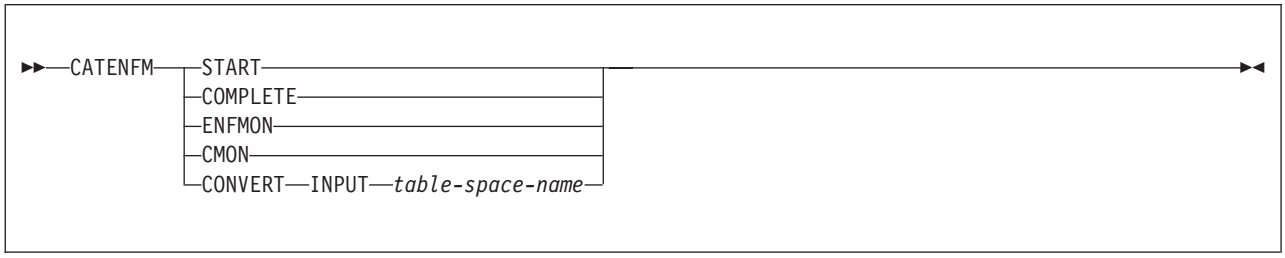
UTILTERM
Performs cleanup

Syntax and options of the CATENFM control statement

The CATENFM utility control statement, with its multiple options, defines the function that the utility job performs.

The CATENFM utility is invoked by jobs DSNTIJEN, DSNTIJNF, DSNTIJES, and DSNTIJCS.

Syntax diagram



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Option descriptions

START
Invokes the CATENFM utility and indicates the start of enabling-new-function mode processing. No start processing is done if CATENFM START was run previously; however, you can run the CATENFM utility as many times as needed.

COMPLETE
Checks if the DB2 subsystem has completed enabling-new-function mode processing. If the subsystem has completed this processing, the CATENFM utility returns 0, and the subsystem enters new-function mode.

ENFMON
Returns DB2 to enabling-new-function mode. If the subsystem is currently in enabling-new-function mode, no change occurs. If the subsystem has been to new-function mode, ENFMON returns it to enabling-new-function* mode. New Version 11 functions are not available in Version 11 enabling-new-function mode.

CMON
Returns DB2 to conversion mode. If the system is currently in conversion mode, no change occurs. If the system has been to enabling-new-function mode or new-function mode, CMON returns it to conversion* mode. Conversion* mode is similar to conversion mode, but the * indicates that at one time the system was in enabling-new-function mode or new-function mode. You can still access objects that were created in enabling-new-function mode or new-function mode. Data sharing groups cannot have any Version 10 members. You cannot fall back to Version 10 from conversion* mode or coexist with a Version 10 system.

CONVERT
Starts enabling-new-function mode processing for the table space that is listed after the INPUT keyword.

INPUT *table-space-name*
Specifies the table space for which enabling-new-function mode processing should begin.

table-space-name
The name of the table space for which enabling-new-function mode processing should begin.

Before converting the catalog

Certain activities might be required before you run the CATMAINT utility, depending on your situation.

Before you run the CATENFM utility to convert the catalog, take image copies of all catalog and directory objects and save your entire subsystem.

To convert the catalog, you must run the DSNTIJEN job.

Data sets that CATENFM uses when converting the catalog

The CATENFM utility uses a number of data sets during its operation.

A CATENFM job allocates all of the data sets that it needs. CATENFM uses data sets only when the CONVERT option is specified.

The following table lists the data sets that CATENFM uses during conversion. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required.

Table 10. Data sets that CATENFM uses during conversion

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for CATENFM

The CATENFM utility has certain concurrency and compatibility characteristics associated with it.

Certain catalog and directory objects are not available during some of the CATENFM phases. The objects that are unavailable vary based on the CATENFM option that you specify. The unavailability of these objects can cause other jobs to time out with message DSNT376I or DSNT501I. You cannot run CATENFM when the DB2 catalog or directory are in UT status.

Converting to new-function mode

The DB2 subsystem leaves conversion mode and enters enabling-new-function mode when you invoke CATENFM START by running the DSNTIJEN job.

About this task

When you migrate to DB2 Version 11, the DB2 subsystem enters conversion mode. In conversion mode, the DB2 subsystem can coexist with other data sharing members that are at either Version 10 or Version 11 conversion mode.

Procedure

To convert to DB2 Version 11 new-function mode:

Invoke CATENFM START by running the DSNTIJEN job.
The subsystem cannot begin enabling-new-function mode processing if any Version 10 members are active in the data sharing group. All members, including members that are not converting to Version 11 new-function mode, must be running Version 11 when the subsystem enters enabling-new-function mode. Note that when a member starts enabling-new-function mode, the group enters enabling-new-function mode.
After enabling-new-function mode completes, the DB2 subsystem can enter Version 11 new-function mode. All new Version 11 functions are unavailable until the DB2 subsystem enters new-function mode.
The DSNTIJEN job runs CATENFM START, which causes the DB2 subsystem to enter enabling-new-function mode. Run CATENFM START only when you are ready to begin the enabling-new-function mode conversion process.

Termination or halt of CATENFM

You can terminate CATENFM by using the TERM UTILITY command.

You can stop the enabling-new-function mode processing by specifying CATENFM HALTENFM or by running job DSNTIJNH. Either action stops the enabling-new-function mode processing at the completion of the step that is currently executing.

CATENFM CONVERT cannot be restarted. If you attempt to restart CATENFM CONVERT, you receive message DSNU181I, which states that the utility cannot be restarted. You must terminate the job, and rerun job DSNTIJEN from the beginning to convert the catalog.

Related reference:

-TERM UTILITY (DB2) (DB2 Commands)

Related information:

DSNU181I (DB2 Messages)

Chapter 11. CATMAINT

The CATMAINT online utility updates the catalog; run this utility during migration to a new release of DB2 or when IBM Software Support instructs you to do so.

Output

Output for CATMAINT UPDATE is the updated catalog.

Authorization required

The required authorization for CATMAINT is installation SYSADM.

Execution phases of CATMAINT

The CATMAINT utility operates in these phases:

Phase Description

UTILINIT
Performs initialization

UTILTERM
Performs cleanup

If the catalog contains plans or packages that were bound with DBPROTOCOL(PRIVATE), the CATMAINT utility executes successfully; however, plans and packages that were bound with DBPROTOCOL(PRIVATE) and access remote locations cannot execute in DB2 for z/OS Version 10 and later. To enable the plans or packages to execute, convert them to use the DRDA® protocol by rebinding them. Use the DSNTP2DP to determine which packages need to be rebound.

Syntax and options of the CATMAINT control statement

The CATMAINT utility control statement, with its multiple options, defines the function that the utility job performs.

Use the ISPF/PDF edit function to create a control statement and to save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

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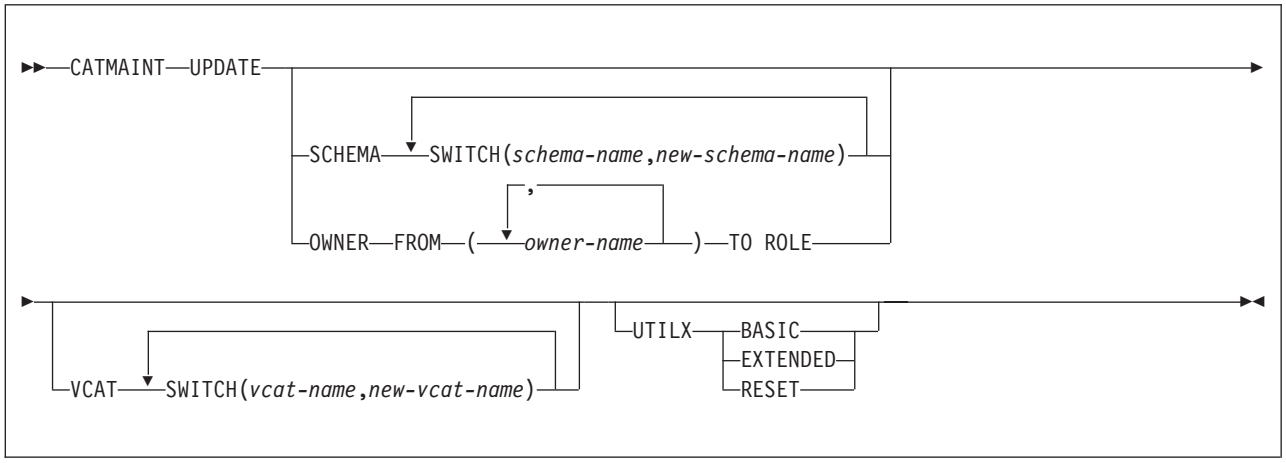
Syntax diagram



Option descriptions

UPDATE
Indicates that you want to update the catalog. Run this option only when you migrate to a new release of DB2 or when IBM Software Support instructs you to do so.

SCHEMA SWITCH*(schema-name,new-schema-name)*
Changes the owner, creator, and schema of database objects. The schema is not changed for views, materialized query tables, SQL scalar function, triggers, and native SQL procedures. The authorization IDs of the creator or owner for plans and packages that use the objects are not changed.

schema-name is a string that identifies the existing owner, creator, or schema to be changed. It will be ignored if it does not identify any owner, creator, or schema names.

schema-name cannot identify a schema or qualifier of an object on which any of the following objects depend:
- Triggers
- Views
- SQL functions
- Materialized query tables
- Native SQL procedures
- Expression-based indexes
- Column masks
- Row permissions

schema-name cannot be referenced in a check condition in any check constraints. Ownership of objects will not be changed if the owner is a role.

new-schema-name specifies the new name for the owner, creator, or schema. The name cannot be a schema that qualifies existing objects.

OWNER FROM*(owner-name)* **TO ROLE**
Changes the ownership of objects from a user to a role. A trusted context must have been created for INSTALL SYSADM before CATMAINT UPDATE OWNER can run. The authorization IDs of the creator or owner for plans and packages that use the objects are not changed.

owner-name specifies the current owner of the object. You can specify multiple owners.

VCAT SWITCH*(vcat-name,new-vcat-name)*

Changes the catalog name that is used by storage groups, user indexes, and table spaces.

vcat-name identifies the integrated catalog facility catalog that is currently used by user-managed data sets for indexes, table spaces, and storage groups.

new-vcat-name specifies the new integrated catalog facility catalog that is to be used by user-managed data sets for indexes, table spaces, and storage groups.

To specify any non-alphanumeric characters, enclose each name in single quotes.

UTILX

Updates the catalog and OBD to the state specified (BASIC or EXTENDED).

- If the table space is already in the requested state no change is made, and a successful message and return code is given.
- If the table space is different from the requested state and the table space is not empty, it fails with a DSNU777I message.
- If the table space is different from the requested state and the table space is empty, the table space is reset to the new state.

BASIC

Initializes SYSUTILX and its indexes to basic 6-byte RBA format. Ensure that all utilities are completed or terminated before you change the format or the command will fail with a DSNU777I message. This option is available in all modes except conversion mode.

EXTENDED

Initializes SYSUTILX and its indexes to extended 10-byte RBA format. Ensure that all utilities are completed or terminated before you change the format or the command will fail with a DSNU777I message. This option is available in all modes except conversion mode.

RESET

Reinitializes the DSNDB01.SYSUTILX directory table space. Because DSNDB01.SYSUTILX contains information about active and outstanding utilities, the process of reinitializing this table space involves determining which objects have a utility in progress and resolving any pending states to make the object available for access. This option is available in conversion mode.

Reinitialize the DSNDB01.SYSUTILX directory table space in any of the following situations:

- You cannot successfully run the DISPLAY UTILITY or TERMINATE UTILITY commands.

After you run this statement, DSNDB01.SYSUTILX is reset to an empty state, and the previous contents are lost. If there were active or stopped utilities at that time, their tracking information is lost and the subsystem might experience unpredictable results. It is important that all utilities that can be terminated are terminated before you run UPDATE UTILX RESET.

Related tasks:

"Reinitializing DSNDB01.SYSUTILX" on page 492

Before running CATMAINT

Certain activities might be required before you run the CATMAINT utility, depending on your situation.

During migration, the work file database is used for CATMAINT sorting. If you are migrating from a previous version, calculate the size of the work file database.

Data sets that CATMAINT uses

The CATMAINT utility uses a number of data sets during its operation.

Include DD statements for all data sets that your job uses. The following table lists the data sets that CATMAINT uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required.

Table 11. Data sets that CATMAINT uses

Data set	Description	Required?
SYSIN	An input data set that contains the utility control statement	Yes
SYSPRINT	An output data set for messages	Yes

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for CATMAINT

The CATMAINT utility has certain concurrency and compatibility characteristics associated with it.

Many catalog and directory indexes are not available while CATMAINT is running. The unavailability of these indexes can cause other jobs to time out with message DSNT318I, DSNT376I or DSNT501I.

Updating the catalog for a new release

When you install or migrate to a new release of DB2, you must update the catalog for the prior release to the new version.

About this task

The DSNTIJTC job runs CATMAINT UPDATE to update the catalog. DB2 displays migration status message DSNU777I at several points during CATMAINT execution.

If an abend occurs during migration processing, message DSNU776I or DSNU778I can give you information about the problem.

Renaming the owner, creator, and schema of database objects

You can rename the owner, creator, and schema of database objects.

Procedure

To rename the owner, creator, and schema of database objects:

Run the CATMAINT utility with the SCHEMA SWITCH options. This process updates every owner, creator or schema name in the catalog and directory that matches the *schema_name* value. All grants that were made by or received by the original owner are changed to the new owner. You can change multiple names by repeating the SWITCH keyword, but you can not specify the same name more than once. The names cannot be longer than 8 bytes in EBCDIC representation. 'SYSIBM' is not allowed as a *schema_name* or *new_schema_name*. OWNER FROM and SCHEMA SWITCH are mutually exclusive. You cannot specify both clauses in the same CATMAINT UPDATE statement.

Changing the ownership of objects from an authorization ID to a role

If a DB2 role is the owner of an object, all users that are associated with that role have the same owner privileges. You can change the owner of an object from an authorization ID to a role by using the CATMAINT utility.

Before you begin

You must be running under a trusted context with a role.

Procedure

To change the ownership of objects from an authorization ID to a role:

Run CATMAINT with the OWNER FROM *owner_name* TO ROLE clause.
The current role will become the owner. All privileges that are held on the object will be transferred from the original owner to the role with the exception of plans and packages. The original user can be the grantor or grantee. After the utility completes, the original owner does not have any privileges to the object .
You can change multiple object owners by specifying multiple *owner_name* values, but you cannot specify the same name more than once. If the *owner_name* value does not own any objects, that value is ignored. SYSIBM is not allowed as an *owner_name* value.
Ownership of roles is changed like other objects. However, if the associated trusted context role is owned by *owner_name*, the ownership of the role will not be changed, because a role cannot be owned by itself.

Related reference:

"Syntax and options of the CATMAINT control statement" on page 73

Related information:

Authorization IDs and roles (Managing Security)

Changing the catalog name used by storage groups or index spaces and table spaces

You can use the CATMAINT online utility to change the catalog name that is used by storage groups or by index spaces and table spaces.

Procedure

To change the catalog name that is used by storage groups or index spaces and table spaces:

Run the CATMAINT VCAT SWITCH utility. The VCAT SWITCH option is similar to the ALTER TABLESPACE USING VCAT statement for changing the catalog

name. You need to move the data for the affected indexes or table spaces to the data set on the new catalog in a separate step. You can change multiple names by repeating the SWITCH keyword, but you cannot specify the same name more than once. The names cannot be longer than 8 bytes in EBCDIC representation. The VCAT SWITCH option has no effect on the system indexes and table spaces in DSNDB06/DSNDB01 because the catalog name is maintained in the parameter.

Identifying invalidated packages after the owner, creator, or schema name of an object is renamed

When the schema name of an object is changed, any packages that are dependent on the object are invalidated. Automatic rebind occurs when the invalidated package is executed.

About this task

Rebind might not be successful if the object is referenced in the application explicitly with the original schema name. In this case, you need to modify the application. The following queries identify the packages that will be invalidated:

GUPI

```
SELECT DISTINCT COLLID, NAME
  FROM SYSIBM.SYSPACKDEP, SYSIBM.SYSPACKAGE
 WHERE BQUALIFIER IN (schema_name1, schema_name2...)
 ORDER BY COLLID, NAME;
```

GUPI

Termination or restart of CATMAINT

You can terminate CATMAINT by using the TERM UTILITY command, but the termination might leave some indexes in REBUILD-pending status.

CATMAINT cannot be restarted. If you attempt to restart CATMAINT, you receive message DSNU181I, which states that the utility cannot be restarted. You must terminate the job with the **TERM UTILITY** command, and rerun CATMAINT from the beginning.

Chapter 12. CHECK DATA

The CHECK DATA online utility checks table spaces for violations of referential and table check constraints, and it reports information about violations that it detects. CHECK DATA checks for consistency between a base table space and the corresponding LOB or XML table spaces.

CHECK DATA does not check LOB table spaces. The utility does not check informational referential constraints.

Run CHECK DATA after a conditional restart or a point-in-time recovery on all table spaces where parent and dependent tables might not be synchronized or where base tables and auxiliary tables might not be synchronized.

Run CHECK DATA to check the integrity of XML documents and their related node ID indexes.

Run CHECK DATA to verify data consistency in hash access tables.

Restriction: Do not run CHECK DATA on encrypted data. Because CHECK DATA does not decrypt the data, the utility might produce unpredictable results.

Output

CHECK DATA SHRLEVEL REFERENCE optionally copies rows and optionally deletes those rows that violate referential or table check constraints. CHECK DATA SHRLEVEL REFERENCE copies each row that violates one or more constraints to an exception table. If a row violates two or more constraints, CHECK DATA SHRLEVEL REFERENCE copies the row only once. For SHRLEVEL CHANGE, CHECK DATA generates REPAIR statements that you can run to delete the rows.

If the utility finds any violation of constraints, the table space that is checked is not put into the CHECK-pending status. You can force the prior behavior, that a table space is put into CHECK-pending status when violations or constraints are detected, by specifying CHECK_SETCHKP=Y on the CHECK_SETCHKP system parameter.

CHECK DATA SHRLEVEL REFERENCE resets CHECK-pending status if it finds no errors or if all rows that contain violations were copied to exception tables and deleted.

CHECK DATA SHRLEVEL CHANGE operates on shadow copies of the table space and generates the corresponding REPAIR statements.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- STATS privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- DATAACCESS authority

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- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute CHECK DATA. However, you cannot use SYSOPR authority to execute CHECK DATA on any object except SYSUTILX in database DSNDB01.

If you are using SHRLEVEL CHANGE, the user ID that invokes COPY with the CONCURRENT option must provide the necessary authority to execute the DFSMSdss COPY command. DFSMSdss will create a shadow data set with the authority of the utility batch address space. The submitter should have an RACF ALTER authority, or its equivalent, for the shadow data set.

If you specify the DELETE option, the privilege set must include the DELETE privilege on the tables that are being checked. If you specify the FOR EXCEPTION option, the privilege set must include the INSERT privilege on any exception table that is used.If you specify the AUXERROR INVALIDATE or the XMLERROR INVALIDATE option, the privilege set must include the UPDATE privilege on the base tables that contain LOB columns.

Execution phases of CHECK DATA

Phase Description

UTILINIT
Performs initialization

CHECKXML
Performs XML structure checking for all XML table spaces specified by INCLUDE XML TABLESPACES.

SCANTAB
Extracts foreign keys; uses an index if the index contains the same columns or a superset of the columns in the foreign key; otherwise scans the table

SORT Sorts foreign keys if they are not extracted from the foreign key index

CHECKDAT
Looks in primary indexes for foreign key parents, checks XML schema validations, checks XML structure, and issues messages to report detected errors

REPORTCK
Copies error rows into exception tables, and delete them from source table if DELETE YES is specified

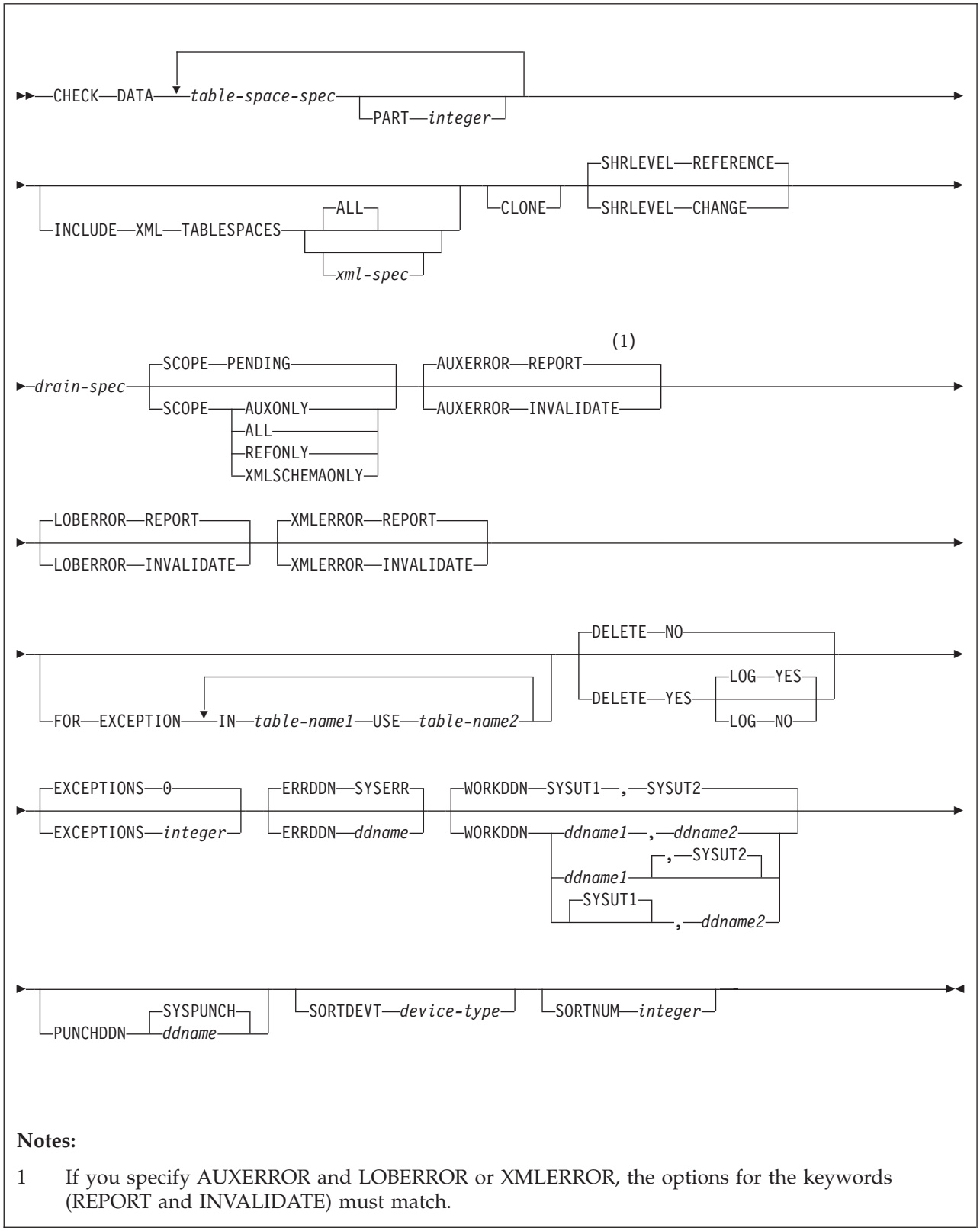
UTILTERM
Performs cleanup

Syntax and options of the CHECK DATA control statement

The CHECK DATA utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After you create it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

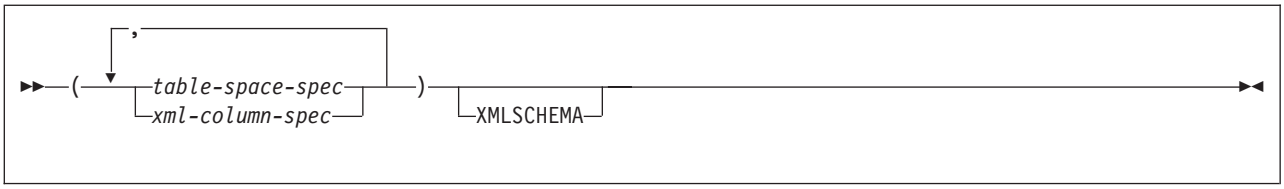
Syntax diagram



Notes:

1 If you specify AUXERROR and LOBERROR or XMLERROR, the options for the keywords (REPORT and INVALIDATE) must match.

xml-spec:



xml-column-spec:

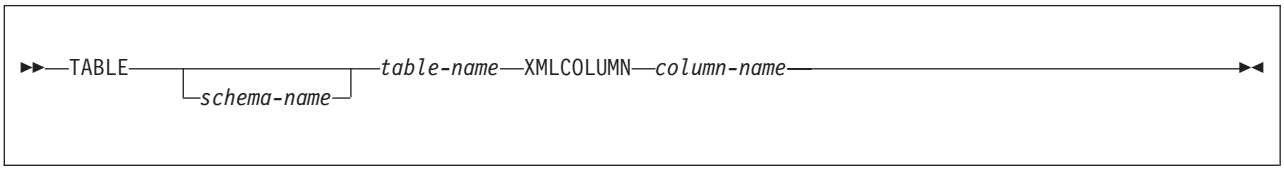
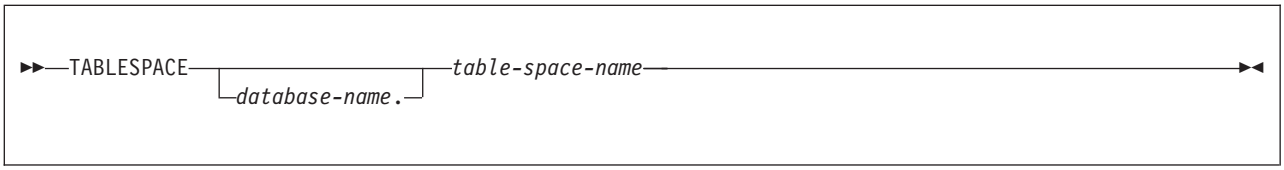
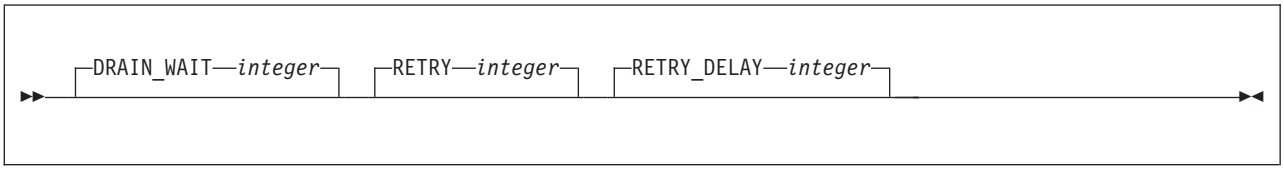


table-space-spec:



drain-spec:



Option descriptions

DATA
Indicates that you want the utility to check referential and table check constraints. CHECK DATA does not check informational referential constraints.

TABLESPACE *database-name.table-space-name*
Specifies the table space to which the data belongs. You can specify base table spaces or, if TABLESPACE is specified as a part of the INCLUDE XML TABLESPACES option, XML table spaces. TABLESPACE cannot be used to specify LOB table spaces.

database-name is the name of the database and is optional. The default value is **DSNDB04**.

table-space-name is the name of the table space.

PART *integer*
Identifies which partition to check for constraint violations.

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

INCLUDE XML TABLESPACES

Indicates that CHECK DATA is to perform consistency checks on the specified XML table spaces and related node ID indexes.

By default, the utility checks only the XML table spaces and their related node ID indexes. If an XML type modifier exists for an XML column and *xml-spec* is specified, XML documents can also be checked against the stored XML schemas. Specify XMLSCHEMA on the *xml-spec* option to enable the check against stored XML schemas.

The consistency checks enabled by INCLUDE XML TABLESPACE are performed in addition to the existing checks specified by the SCOPE keyword.

XML indexes that are associated with the XML table spaces that are checked are not verified. Run the CHECK INDEX utility separately on those indexes.

The following checks are performed:

- The XML table space is checked to ensure that all rows of each XML document are present in the XML table space and that the XML document is structurally intact.
- All entries in the node ID index are checked against the rows in the XML table space. Each index entry must have a corresponding row in the XML table space, and vice versa. This functionality is equivalent to running the CHECK INDEX utility on the node ID index.
- All values in the document ID column are checked against the node ID index. Each document ID value must have matching entries in the node ID index. Each node ID index value must also have a document ID value.
- If XMLSCHEMA is specified, CHECK DATA validates documents that are stored in that column. When a document is validated, the base table row is updated with the validated document that is returned when SHRLEVEL REFERENCE and XMLERROR INVALIDATE or AUXERROR INVALIDATE are specified.

ALL

Checks all XML table spaces that are related to the base table spaces that are identified by the *table-space-spec*. Specifying ALL is equivalent to explicitly specifying all the XML column identifiers.

xml-spec

Checks only those XML table spaces and related node ID indexes that are identified by either the XML column of a table or by the explicit table space name.

Each XML column has a single XML table space that is associated with it. Therefore, an XML table space can be identified either by the XML column of the base table or by the explicit table space name.

If an XML column identifier is used, the utility finds the name of the XML table space in the DB2 catalog or the database directory.

table-space-spec

Identifies an XML table space to check. The XML table space specification must identify an XML table space that has a corresponding column in a base table. The base table must reside in the table space that is identified by the *table-space-spec* option of the main CHECK DATA control statement.

xml-column-spec

Identifies an XML table space to check by the XML column of the XML table space in a base table. An XML column identifier consists of the

fully qualified table name and the name of the XML column. An XML column identifier must reference a table in any one of the base table spaces that are to be checked.

XMLSCHEMA
Specifies that if the XML columns have an XML type modifier, the CHECK DATA utility checks the XML documents against the stored XML schema.

CLONE
Indicates that CHECK DATA is to check the clone table in the specified table space. Because clone tables cannot have referential constraints, the utility checks only constraints for inconsistencies between the clone table data and the corresponding LOB data. If you do not specify CLONE, CHECK DATA operates against only the base table.

SHRLEVEL
Indicates the type of access that is to be allowed for the index, table space, or partition that is to be checked during CHECK DATA processing.

REFERENCE
Specifies that applications can read from but cannot write to the index, table space, or partition that is to be checked.

The CHECK DATA utility can write changes to the table space, index space, or partition during processing.

Restriction: You cannot run CHECK DATA with the SHRLEVEL REFERENCE option on a table space that contains an archive-enabled table or system-period temporal table when one of the following options is also specified:

- DELETE YES
- LOBERROR INVALIDATE
- AUXERROR INVALIDATE
- XMLERROR INVALIDATE

CHANGE
Specifies that applications can read from and write to the index, table space, or partition that is to be checked.

The CHECK DATA utility operates on shadow copies only and does not change the table space, index space, or partition during processing. REPAIR statements are generated for any changes to be made and are written to the data set that is indicated in the PUNCHDDN option. CHECK DATA does not generate REPAIR statements for inconsistencies that it finds in compressed rows if you specify SHRLEVEL CHANGE and one of the following options:

- AUXERROR INVALIDATE
- LOBERROR INVALIDATE
- XMLERROR INVALIDATE

If you specify SHRLEVEL CHANGE, DB2 performs the following actions:

- Drains all writers and forces the buffers to disk for the specified object and all of its indexes
- Invokes DFSMSdss to copy the specified object and all of its indexes to shadow data sets
- Enables read/write access for the specified object and all of its indexes

- Runs CHECK INDEX on the shadow data sets

By default, DFSMSdss uses FlashCopy to copy DB2 objects to shadow data sets, if FlashCopy is available. If DFSMSdss cannot use FlashCopy, DFSMSdss uses a slower method. As a result, creating copies of objects might take a long time, and the time during which the data and indexes have read-only access might increase. You can set the CHECK_FASTREPLICATION subsystem parameter to REQUIRED to force the CHECK utility to use only FlashCopy. If FlashCopy is not available, the CHECK utility fails.

DRAIN_WAIT
Specifies the number of seconds that CHECK DATA is to wait when it drains the table space or index. The specified time is the aggregate time for objects that are to be checked. This value overrides the values that are specified by the IRLMRWT and UTIMOUT subsystem parameters.

integer can be any integer from 0 to 1800. If you do not specify DRAIN_WAIT or specify a value of 0, CHECK DATA uses the value of the lock timeout subsystem parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of retries that CHECK DATA is to attempt.

integer can be any integer from 0 to 255. If you do not specify RETRY, CHECK DATA uses the value of the utility multiplier system parameter UTIMOUT.

Specifying RETRY can increase processing costs and result in multiple or extended periods during which the specified index, table space, or partition is in read-only access.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between retries. *integer* can be any integer from 1 to 1800.

If you do not specify RETRY_DELAY, CHECK DATA uses the smaller of the following two values:

- DRAIN_WAIT value × RETRY value
- DRAIN_WAIT value × 10

SCOPE
Limits the scope of the rows in the table space that are to be checked.

PENDING
Indicates that the only rows to be checked are those rows that are in table spaces, partitions, or tables that are in CHECK-pending (CHKP) status. For each or these rows, CHECK DATA checks all referential and check constraints and LOB and XML columns.

When CHECK DATA checks XML columns, the utility verifies the relationship between the node ID index and the values in the XML indicator column in the base table space. If the INCLUDE XML TABLESPACES option is specified, CHECK DATA also validates the schema for all specified XML table spaces that satisfy both of the following conditions:

- Are in CHKP status
- Reference a table in any of the base table spaces to be checked

If you specify SCOPE PENDING for a table space that is not in CHKP status, CHECK DATA does not check the table space. The utility does not issue an error message.

AUXONLY
Indicates that only the LOB and XML columns are to be checked for table spaces that have tables with LOB columns or XML columns. CHECK DATA does not check referential and check constraints.

When CHECK DATA checks XML columns, the utility verifies only the relationship between the node ID index and the values in the XML indicator column in the base table space.

ALL
Indicates that all dependent tables in the specified table spaces are to be checked. CHECK DATA checks all referential and check constraints and LOB and XML columns.

If the INCLUDE XML TABLESPACES option is specified, the associated XML table space and node ID index are checked for structural defects and inconsistencies.

REFONLY
Indicates the same behavior as the ALL option, except that the LOB and XML columns are not checked. CHECK DATA checks all referential and check constraints.

XMLSCHEMAONLY
Indicates that only the XML schema is to be validated for the XML objects that are specified by the INCLUDE XML TABLESPACE option. CHECK DATA does not check XML and LOB column integrity or referential and check constraints.

AUXERROR
Specifies the action that CHECK DATA is to perform when it finds a LOB or XML column check error.

REPORT
A LOB or XML column check error is reported with a warning message. The base table space is set to the auxiliary CHECK-pending (ACHKP) status.

Note: CHECK DATA sets the base table space to ACHKP status if SHRLEVEL REFERENCE is specified. If SHRLEVEL CHANGE is specified, CHECK DATA does not change the status of the base table space.

INVALIDATE
A LOB or XML column check error is reported with a warning message. The base table LOB or XML column is set to an invalid status. A LOB or XML column with invalid status that is now correct is set valid. This action is also reported with a message. The base table space is set to the auxiliary warning (AUXW) status if any LOB column remains in invalid status.

If SHRLEVEL REFERENCE is specified, CHECK DATA sets the base table of a LOB or XML column to an invalid status and the base table space to AUXW status. If SHRLEVEL CHANGE is specified, CHECK DATA does not change the status of the base table space or a LOB or XML column.

If SHRLEVEL REFERENCE and INCLUDE XML TABLESPACES are specified, CHECK DATA deletes corrupted XML documents and the associated node ID index entries. If the node ID index is not consistent with the content in the XML table, CHECK DATA corrects the node ID index.

Restrictions: You cannot run CHECK DATA SHRLEVEL REFERENCE with AUXERROR INVALIDATE on the following objects:

- A table or a history table that is defined with data versioning
- A table space that contains an archive-enabled table

Before you use CHECK DATA to check a LOB or XML column, take the following actions:

1. Run CHECK LOB to ensure the validity of the LOB table space.
2. Run REBUILD INDEX or CHECK INDEX on the index on the auxiliary table to ensure its validity.
3. Run REBUILD INDEX or CHECK INDEX on the NODE ID index on the XML table space to ensure its validity.

LOBERROR

Specifies the action that CHECK DATA is to perform when it finds a LOB column check error. Do not specify LOBERROR if AUXERROR is specified. If both are specified, the keywords must match. LOBERROR is ignored for SCOPE XMLONLY since LOB checking is not being performed.

REPORT

A LOB column check error is reported with a warning message. The base table space is set to the auxiliary CHECK-pending (ACHKP) status.

If AUXERROR is not specified, the default value is **REPORT**.

INVALIDATE

A LOB column check error is reported with a warning message. The base table LOB column is set to an invalid status. A LOB column with invalid status that is now correct is set valid. The base table space is set to the auxiliary warning (AUXW) status if any LOB column remains in invalid status.

Restrictions: You cannot run CHECK DATA with LOBERROR INVALIDATE on the following objects:

- A table or a history table that is defined with data versioning
- A table space that contains an archive-enabled table if SHRLEVEL REFERENCE is also specified

XMLERROR

Specifies the action that CHECK DATA is to perform when it finds an XML column check error. Do not specify XMLERROR if AUXERROR is specified. If both are specified, the keywords must match. XMLERROR is ignored for SCOPE XMLONLY since LOB checking is not being performed.

REPORT

An XML column check error is reported with a warning message. The base table space is set to the auxiliary CHECK-pending (ACHKP) status.

If AUXERROR is not specified, the default value is **REPORT**.

Note: CHECK DATA sets the base table space to ACHKP status if SHRLEVEL REFERENCE is specified. If SHRLEVEL CHANGE is specified, CHECK DATA does not change the status of the base table space.

INVALIDATE

An XML column check error is reported with a warning message. The base table XML column is set to an invalid status. An XML column with invalid

status that is now correct is set valid. The base table space is set to the auxiliary warning (AUXW) status if any LOB column remains in invalid status.

CHECK DATA sets the base table of a LOB or XML column to an invalid status and the base table space to AUXW only if SHRLEVEL REFERENCE is specified. If SHRLEVEL CHANGE is specified, CHECK DATA does not change the status of the base table space or a LOB or XML column.

If SHRLEVEL REFERENCE and INCLUDE XML TABLESPACES are specified, CHECK DATA deletes corrupted XML documents and the associated node ID index entries. If the node ID index is not consistent with the content in the XML table, CHECK DATA corrects the node ID index.

Restrictions: You cannot run CHECK DATA SHRLEVEL REFERENCE with XMLERROR INVALIDATE on the following objects:

- A table or a history table that is defined with data versioning
- A table space that contains an archive-enabled table

FOR EXCEPTION

Indicates that any row that is in violation of referential or table check constraints is to be copied to an exception table. Although this keyword does not apply to the checking of LOB or XML columns, rows with LOB or XML columns are moved to the exception tables. If you specify AUXONLY for LOB and XML checking only, the FOR EXCEPTION option is ignored.

If any row violates more than one constraint, that row is included only once in the exception table.CHECK DATA includes checking for XML schema violations and XML structure checking.

This option is ignored when SHRLEVEL CHANGE is specified.

If you run CHECK DATA on a base table with XML columns, the EXCEPTIONS keyword has an effect only if the INCLUDE XML TABLESPACES option is also specified.

IN *table-name1*
Specifies the table (in the table space that is specified on the TABLESPACE keyword) from which rows are to be copied.

table-name1 is the name of the table.

USE *table-name2*
Specifies the exception table into which error rows are to be copied.

table-name2 is the name of the exception table and must be a base table; it cannot be a view, synonym, or alias.

For both *table-name1* and *table-name2*, enclose the table name in quotation marks if the name contains a blank or a special character. (A *special character* is any character other than a letter or a digit.)

DELETE
Indicates whether rows that are in violation of referential or table check constraints are to be deleted from the table space.

NO Indicates that error rows are to remain in the table space. Primary errors in dependent tables are copied to exception tables.

If DELETE NO and SHRLEVEL REFERENCE are specified, and constraint violations are detected, CHECK DATA places the table space in the CHECK-pending status.

YES
Indicates that error rows are to be deleted from the table space.

You can specify DELETE YES only if you specify the FOR EXCEPTION clause. When you specify FOR EXCEPTION, deleted rows from both dependent and descendant tables are placed into exception tables.

If you specify SHRLEVEL REFERENCE, error rows are deleted from the table space. If you specify SHRLEVEL CHANGE, CHECK DATA generates REPAIR LOCATE DELETE statements that you can run to delete the rows. These statements are written to the PUNCHDDN data set.

Important: Check any generated REPAIR statements after you run CHECK DATA SHRLEVEL CHANGE on tables that have data versioning activated or on history tables. Historic information could be deleted.

If you delete rows from a table space that is not logged, the table space is placed in informational COPY-pending (ICOPY) status.

Restrictions: You cannot run CHECK DATA with DELETE YES on the following objects:

- A table or a history table that is defined with data versioning
- A table space that contains an archive-enabled table if SHRLEVEL REFERENCE is also specified

LOG
Specifies the logging action that is to be taken when records are deleted.

YES
Logs all records that are deleted during the REPORTCK PHASE.

If the table space has the NOT LOGGED attribute, LOG YES is ignored.

NO

Does not log any records that are deleted during the REPORTCK phase. If any rows are deleted, CHECK DATA places the table space in COPY-pending status and any indexes with the COPY YES attribute in informational COPY-pending status. If rows are deleted from a table space that is not logged, the table space is marked informational COPY-pending.

Attention: Use the LOG NO option with caution because its use limits your ability to recover data by using the log. For example, suppose that you issue a CHECK DATA DELETE YES LOG NO statement at particular log RBA. You can recover data that exists on the log before that point in time or after the point on the log at which the utility execution completes.

EXCEPTIONS *integer*
Specifies the maximum number of exceptions, which are reported by messages only. CHECK DATA terminates in the CHECKDATA phase when it reaches the specified number of exceptions; if termination occurs, the error rows are not written to the EXCEPTION table.

Only records that contain primary referential integrity errors or table check constraint violations are applied toward the exception limit. The number of records that contain secondary errors is not limited.

integer is the maximum number of exceptions. The default value is **0**, which indicates no limit on the number of exceptions.

This keyword does not apply to LOB table spaces or base table spaces that contain XML columns.

ERRDDN *ddname*
Specifies a DD statement for an error processing data set.

ddname is either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name. The default value is**SYSERR**.

WORKDDN (*ddname1***,***ddname2***)**
Specifies the DD statements for the temporary work file for sort input and the temporary work file for sort output. A temporary work file for sort input and output is required.

You can use the WORKDDN keyword to specify either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, WORKDDN uses the DD name.

ddname1 is the DD name of the temporary work file for sort input. The default is **SYSUT1**.

ddname2 is the DD name of the temporary work file for sort output. The default is **SORTOUT**.

PUNCHDDN *ddname*
Specifies the DD statement for a data set that is to receive the REPAIR utility control statements that CHECK DATA SHRLEVEL CHANGE generates.

ddname is the DD name.

The default value is **SYSPUNCH**.

The PUNCHDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a name in the current job step and a TEMPLATE name, the utility uses the DD name.

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by a sort program. You can specify any disk device type that is acceptable to the DYNALLOC parameter of the SORT or OPTION control statement for the sort program.

Do not use a TEMPLATE specification to dynamically allocate sort work data sets. The presence of the SORTDEVT keyword controls dynamic allocation of these data sets.

device-type is the device type. If you omit SORTDEVT and a sort is required, you must provide the DD statements that the sort program requires for the temporary data sets.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated by the sort program.

integer is the number of temporary data sets that can range from 2 to 255.

If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility.

Important: The SORTNUM keyword is not considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

Related concepts:

"Subsystem parameters for refining DFSMSdss COPY operation with utilities" on page 48

Related reference:

Chapter 35, "TEMPLATE," on page 789

Before running CHECK DATA

Certain activities might be required before you run the CHECK DATA utility, depending on your situation.

For a table with no LOB columns

Before running CHECK DATA, you should run CHECK INDEX on primary key indexes and foreign key indexes to ensure that the indexes that CHECK DATA uses are valid. This action is especially important before using CHECK DATA with the DELETE YES or PART options.

For a table with LOB columns

If you plan to run CHECK DATA on a base table space that contains at least one LOB column, complete the following steps prior to running CHECK DATA:

1. Run CHECK LOB on the LOB table space.
2. Run CHECK INDEX on the index on the auxiliary table to ensure the validity of the LOB table space and the index on the auxiliary table.
3. Run CHECK INDEX on the indexes on the base table space.

The relationship between a base table with a LOB column and the LOB table space is shown in the following figure. The LOB column in the base table points to the auxiliary index on the LOB table space, as illustrated in the figure.

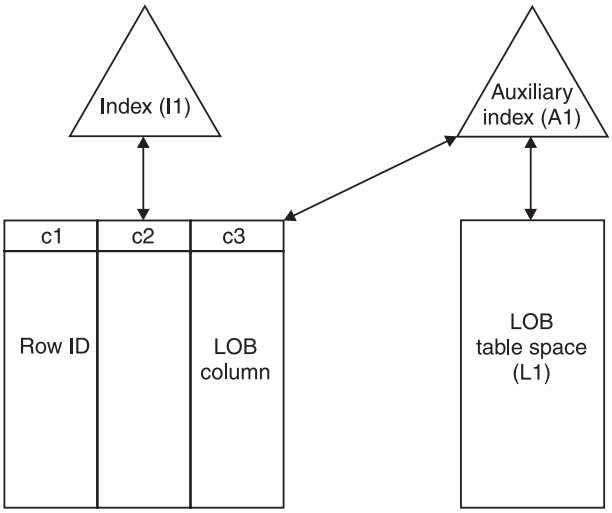


Figure 7. Relationship between a base table with a LOB column and the LOB table space

If the LOB table space is in either the CHECK-pending or RECOVER-pending status, or if the index on the auxiliary table is in REBUILD-pending status, CHECK DATA issues an error message and fails.

Complete all LOB column definitions. You must complete all LOB column definitions for a base table before running CHECK DATA. A LOB column definition is not complete until the LOB table space, auxiliary table, and index on the auxiliary table have been created. If any LOB column definition is not complete, CHECK DATA fails and issues error message DSNU075E.

For an XML table space

Before running CHECK DATA, run CHECK INDEX on the node ID index of each XML column. If you need to determine the XML objects, query the SYSXMLRELS catalog table.

Data sets that CHECK DATA uses

The CHECK DATA utility uses a number of data sets during its operation.

The following table lists the data sets that CHECK DATA uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 12. Data sets that CHECK DATA uses

Data set	Description	Required?
SYSIN	An input data set that contains the utility control statement.	Yes
SYSPRINT	An output data set for messages.	Yes
Work data sets	Two temporary data sets for sort input and sort output. Specify the DD names by using the WORKDDN option of the utility control statement. The default *ddname* for sort input is SYSUT1. The default *ddname* for sort output is SORTOUT.	Yes

Table 12. Data sets that CHECK DATA uses (continued)

Data set	Description	Required?
Error data set	An output data set that collects information about violations that are encountered during the CHECKDAT phase for referential constraints or the SCANTAB phase for check constraints. Specify the DD name by using the ERRDDN parameter of the utility control statement. The default *ddname* is SYSERR.	Yes
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space
Object that is to be checked. (If you want to check only one partition of a table space, use the PART option in the control statement.)

Exception table
Table that stores rows that violate any referential constraints. For each table in a table space that is checked, specify the name of an exception table in the utility control statement. Any row that violates a referential constraint is copied to the exception table.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. It is recommended that at least 1.2 times the amount of data to be sorted be provided in sort work data sets on disk.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Defining work data sets

Three sequential data sets are required during execution of CHECK DATA. Two work data sets and one error data set are described by DD statements in the WORKDDN and ERRDDN options.

Procedure

To define work data sets:

1. Find the approximate size, in bytes, of the WORKDDN data set:

Option	Description
If a table space has a LOB column	Count a total of 70 bytes for the LOB column and multiply the sum by the number of keys and LOB columns that are checked.

Option	Description
If a table space does not have a LOB column	Add 18 to the length of the longest foreign key. For nonpadded indexes, the length of the longest foreign key is the maximum possible length of the key with all varying-length columns in the key padded to their maximum length, plus 2 bytes for each varying-length column.

2. Create the ERRDDN data set so that it is large enough to accommodate one error entry (length=60 bytes) per violation that CHECK DATA detects.

Shadow data sets

When you execute the CHECK DATA utility with the SHRLEVEL CHANGE option, the utility uses shadow data sets.

If a table space, partition, or index resides in DB2-managed data sets and shadow data sets do not already exist when you execute CHECK DATA, DB2 creates the shadow data sets. At the end of CHECK DATA processing, the DB2-managed shadow data sets are deleted.

For user-managed data sets, DFSMSdss can create, or scratch and re-create, the required shadow data sets as needed. When the CHECK DATA utility completes the processing of user-managed data sets, the shadow data sets are not automatically scratched.

If you do not want the shadow data sets to be allocated in the same storage class as the production data sets, set the UTIL_TEMP_STORCLAS system parameter to specify the storage class for the shadow data sets.

Shadow data set names

Each shadow data set must have the following name:

catname.DSNDB*x*.*dbname*.*psname*.*y*000*z*.*Lnnn*

In the preceding name, the variables have the following meanings:

variable
: **meaning**

catname
: The VSAM catalog name or alias

x
: C or D

dbname
: Database name

psname
: Table space name or index name

y
: I or J

z
: 1 or 2

Lnnn
: Partition identifier. Use one of the following values:
  - A001 through A999 for partitions 1 through 999

- B000 through B999 for partitions 1000 through 1999
- C000 through C999 for partitions 2000 through 2999
- D000 through D999 for partitions 3000 through 3999
- E000 through E996 for partitions 4000 through 4096

GUPI To determine the names of existing data sets, execute one of the following queries against the SYSTABLEPART or SYSINDEXPART catalog tables:

```
SELECT DBNAME, TSNAME, IPREFIX
  FROM SYSIBM.SYSTABLEPART
  WHERE DBNAME = 'dbname'
  AND TSNAME = 'psname';
```

```
SELECT DBNAME, IXNAME, IPREFIX
  FROM SYSIBM.SYSINDEXES X, SYSIBM.SYSINDEXPART Y
  WHERE X.NAME = Y.IXNAME
  AND X.CREATOR = Y.IXCREATOR
  AND X.DBNAME = 'dbname'
  AND X.INDEXSPACE = 'psname';
```

GUPI

For a partitioned table space, DB2 returns rows from which you select the row for the partitions that you want to check.

Defining shadow data sets

For a partitioned table space, DB2 returns rows from which you select the row for the partitions that you want to check.

Consider the following actions when you preallocate the data sets:

- Allocate the shadow data sets according to the rules for user-managed data sets.
- Define the shadow data sets as LINEAR.
- Use SHAREOPTIONS(3,3).
- Define the shadow data sets as EA-enabled if the original table space or index space is EA-enabled.
- Allocate the shadow data sets on the volumes that are defined in the storage group for the original table space or index space.

If you specify a secondary space quantity, DB2 does not use it. Instead, DB2 uses the SECQTY value for the table space or index space.

Recommendation: Use the MODEL option, which causes the new shadow data set to be created like the original data set. This method is shown in the following example:

```
DEFINE CLUSTER +
   (NAME('catname.DSNDBC.dbname.psname.x0001.L001') +
   MODEL('catname.DSNDBC.dbname.psname.y0001.L001')) +
   DATA +
   (NAME('catname.DSNDBD.dbname.psname.x0001.L001') +
   MODEL('catname.DSNDBD.dbname.psname.y0001.L001'))
```

Creating shadow data sets for indexes

When you preallocate shadow data sets for indexes, create the data sets as follows:

- Create shadow data sets for the partition of the table space and the corresponding partition in each partitioning index and data-partitioned secondary index.
- Create a shadow data set for logical partitions of nonpartitioned secondary indexes.

Use the same naming scheme for these index data sets as you use for other data sets that are associated with the base index, except use J0001 instead of I0001.

Estimating the size of shadow data sets

If you have not changed the value of FREEPAGE or PCTFREE, the amount of required space for a shadow data set is comparable to the amount of required space for the original data set.

Concurrency and compatibility for CHECK DATA

The CHECK DATA utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims and drains

The following table shows which claim classes CHECK DATA claims and drains and any restrictive status that the utility sets on the target object. The legend for these claim classes is located at the bottom of the table.

Table 13. Claim classes of CHECK DATA operations

Target objects	CHECK DATA DELETE NO	CHECK DATA DELETE YES	CHECK DATA PART DELETE NO	CHECK DATA PART DELETE YES
Table space or partition	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Partitioning index or index partition	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Secondary index	DW/UTRO	DA/UTUT	none	DR
Logical partition of index	none	none	DW/UTRO	DA/UTUT
Primary index	DW/UTRO	DW/UTRO	DW/UTRO	DW/UTRO
RI dependent and descendent table spaces and indexes	none	DA/UTUT	none	DA/UTUT
RI exception table spaces and indexes (FOR EXCEPTION only)	DA/UTUT	DA/UTUT	DA/UTUT	DA/UTUT

Table 13. Claim classes of CHECK DATA operations (continued)

Target objects	CHECK DATA DELETE NO	CHECK DATA DELETE YES	CHECK DATA PART DELETE NO	CHECK DATA PART DELETE YES

Legend:
- DA: Drain all claim classes, no concurrent SQL access
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers
- DW: Drain the write claim class, concurrent access for SQL readers
- UTUT: Utility restrictive state, exclusive control
- UTRO: Utility restrictive state, read-only access allowed
- none: Object not affected by this utility
- RI: Referential Integrity

The following table shows claim classes on a LOB table space and an index on the auxiliary table.

Table 14. Claim classes of CHECK DATA operations on a LOB table space and index on the auxiliary table

Target objects	CHECK DATA DELETE NO	CHECK DATA DELETE YES
LOB table space	DW/UTRO	DA/UTUT
Index on the auxiliary table	DW/UTRO	DA/UTUT

Legend:
- DW: Drain the write claim class, concurrent access for SQL readers
- DA: Drain all claim classes, no concurrent SQL access
- UTRO: Utility restrictive state, read-only access allowed
- UTUT: Utility restrictive state, exclusive control

The following table shows claim classes of XML objects.

Table 15. Claim classes of XML objects

Target objects	CHECK DATA DELETE NO	CHECK DATA DELETE YES
XML table space	DW/UTRO	DA/UTUT
document ID and node ID indexes	DW/UTRO	DA/UTUT
XML index	DW/UTRO	DA/UTUT

Legend:
- DW: Drain the write claim class, concurrent access for SQL readers
- DA: Drain all claim classes, no concurrent SQL access
- UTRO: Utility restrictive state, read-only access allowed
- UTUT: Utility restrictive state, exclusive control

When you specify CHECK DATA AUXERROR INVALIDATE, a drain-all is performed on the base table space, and the base table space is set UTUT.

Compatibility

The following utilities are compatible with CHECK DATA and can run concurrently on the same target object:
- DIAGNOSE
- MERGECOPY
- MODIFY

- REPORT
- STOSPACE
- UNLOAD (when CHECK DATA DELETE NO)

SQL operations and other online utilities are incompatible.

To run on DSNDB01.SYSUTILX, CHECK DATA must be the only utility in the job step and the only utility that is running in the DB2 subsystem.

The index on the auxiliary table for each LOB column inherits the same compatibility and concurrency attributes of a primary index.

Exception tables for the CHECK DATA utility

An *exception table* is a user-created table that duplicates the definition of a dependent table. The CHECK DATA utility checks the number of columns in the dependent table. The CHECK DATA utility also copies the deleted rows from the dependent table to the exception table.

The following table describes the contents of an exception table. This table lists the columns, a description of the column content, whether or not the column is required, the data type and length of the column value, and whether or not the column has the NULL attribute.

Table 16. Contents of exception tables

Column	Description	Required?	Data type and length	NULL attribute
1 to *n*	Corresponds to columns in the table that is being checked. These columns hold data from table rows that violate referential or table check constraints.	Yes	The same as the corresponding columns in the table that is being checked.	The same as the corresponding columns in the table that is being checked.
n+1	Identifies the RIDs of the invalid rows of the table that is being checked.	No	CHAR(4); CHAR(5)[1] for table spaces that are defined with LARGE or DSSIZE options	Anything
n+2	Indicates the starting time of the CHECK DATA utility.	No	TIMESTAMP	Anything
≥ *n*+2	Additional columns that the CHECK DATA utility does not use.	No	Anything	Anything

Note:

1. You can use CHAR(5) for any type of table space, but you must use it for table spaces that are defined with the LARGE or DSSIZE options.

If you delete rows by using the CHECK DATA utility with SCOPE ALL, you must create exception tables for all tables that are named in the table spaces and for all their descendents. All descendents of any row are deleted.

When creating or using exception tables, be aware of the following guidelines:

- The exception tables should not have any unique indexes or referential or table check constraints that might cause errors when CHECK DATA inserts rows into them.

- You can create a new exception table before you run CHECK DATA, or you can use an existing exception table. The exception table can contain rows from multiple invocations of CHECK DATA.
- If column *n*+2 is of type TIMESTAMP, CHECK DATA records the starting time. Otherwise, it does not use column *n*+2.
- You must have DELETE authorization on the dependent table that is being checked.
- You must have INSERT authorization on the exception table.
- Column names in the exception table can have any name.
- Any change to the structure of the dependent table (such as a dropped column) is not automatically recorded in the exception table. You must make that change in the exception table.

Related reference:

CREATE TABLE (DB2 SQL)

Exception processing for tables with auxiliary columns

CHECK DATA writes constraint violations to exception tables. The exception table for the base table must have a similar auxiliary column and an auxiliary table space for each auxiliary column.

If an exception is found, DB2 moves the base table row with its auxiliary column to the exception table. If you specify DELETE YES, DB2 deletes the base table row and the auxiliary column.

An auxiliary table cannot be an exception table. A LOB column check error is not included in the exception count. A row with only a LOB column check error does not participate in exception processing.

Specifying the scope of CHECK DATA

Running CHECK DATA with SCOPE PENDING is normally sufficient. DB2 records which data rows must be checked to ensure the referential integrity of the table space.

About this task

You can find inconsistencies in the XML table space, the node ID index, or in the relationship between the document ID column and the node ID index by running the CHECK DATA utility.

Running CHECK DATA with SCOPE ALL or SCOPE AUXONLY and specifying INCLUDE XML TABLESPACES enables the XML structure checking of the specified XML table spaces and consistency checking of the XML columns in the base table and their associated node ID indexes. Specifying XMLSCHEMAONLY with INCLUDE XML TABLESPACES limits the CHECK DATA scope to only XML schema validation for the XML columns.

Procedure

To specify the scope of CHECK DATA:

Use one of the following approaches:

- If the scope information is in doubt, run the utility with the SCOPE ALL option. The scope information is recorded in the DB2 catalog. The scope information can become indoubt whenever you start the target table space with ACCESS(FORCE), or when the catalog is recovered to a point in time.
- If you want to check only the tables with LOB columns, specify the AUXONLY option. If you want to check all dependent tables in the specified table spaces **except** tables with LOB columns, specify the REFONLY option.

How violations are identified

CHECK DATA issues a message for every row that contains a referential constraint violation or table check constraint violation.

The violation is identified by:
- The RID of the row
- The name of the table that contains the row
- The name of the constraint that is being violated

The following figure shows an example of messages that CHECK DATA issues.

```
DSNU0501   DSNUGUTC - CHECK DATA TABLESPACE DBJM1203.TLJM1203
            TABLESPACE DBJM1203.TPJM1204
            FOR EXCEPTION IN TLJM1203.TBJM1203 USE ADMF001.EXCPT3
            IN TPJM1204.TBJM1204 USE ADMF001.EXCPT4 DELETE YES
DSNU7271 = DSNUKINP - TABLESPACE 'DBJM1203.TLJM1203' IS NOT CHECK PENDING

DSNU7301   DSNUKDST - CHECKING TABLE TPJM1204.TBJM1204
DSNU0421   DSNUGSOR - SORT PHASE STATISTICS -
            NUMBER OF RECORDS=4
            ELAPSED TIME=00:00:00
DSN0733I   DSNUKERK - ROW (RID=X'000000020B') HAS NO PARENT FOR
TPJM1204.TBJM1204.TABFK
DSN0733I   DSNUKERK - ROW (RID=X'0010000201') HAS NO PARENT FOR
TPJM1204.TBJM1204.TABFK
DSN0733I   DSNUKERK - ROW (RID=X'002000020B') HAS NO PARENT FOR
TPJM1204.TBJM1204.TABFK
DSN0733I   DSNUKERK - ROW (RID=X'0030000201') HAS NO PARENT FOR
TPJM1204.TBJM1204.TABFK
DSNU739I   DSNUKDAT - CHECK TABLE TPJM1204.TBJM1204 COMPLETE, ELAPSED
TIME=00:00:00
DSNU741I = DSNUKRDY - 4 ROWS DELETED FROM TABLE TPJM1204.TBJM1204
DSNU568I = DSNUGSRX - INDEX TPJM1204.IPJM1204 IS IN INFORMATIONAL COPY PENDING
DSNU568I = DSNUGSRX - INDEX TPJM1204.IXJM1204 IS IN INFORMATIONAL COPY PENDING
DSNU7491   DSNUK001 - CHECK DATA COMPLETE,ELAPSED TIME=00:00:02
DSNU010I   DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=4
```

Figure 8. Example of messages that CHECK DATA issues

Detection and correction of constraint violations

You can avoid problems by running CHECK DATA with DELETE NO to detect violations before you attempt to correct the errors.

If required, use DELETE YES after you analyze the output and understand the errors.

You can automatically delete rows that violate referential or table check constraints by specifying CHECK DATA with DELETE YES. However, you should be aware of the following possible problems:

- The violation might be created by a non-referential integrity error. For example, the indexes on a table might be inconsistent with the data in a table.
- Deleting a row might cause a cascade of secondary deletes in dependent tables. The cascade of deletes might be especially inconvenient within referential integrity cycles.
- The error might be in the parent table.

CHECK DATA uses the primary key index and all indexes that exactly match a foreign key. Therefore, before running CHECK DATA, ensure that the indexes are consistent with the data by using the CHECK INDEX utility.

CHECK DATA XML error detection

Run CHECK DATA with the INCLUDE XML TABLESPACES option to verify the consistency of the XML table space and the node ID index.

The following checks are performed:

- Verify that all rows that comprise an XML document exist in the XML table space and that all nodes in that XML document are structurally intact.
- Verify that the node ID index is consistent with the content in the XML table space. No index entries must exist without an associated XML document and each XML document in the XML table space must have corresponding entries in the node ID index.
- Verify that the references from the base table space ID column contains only entries that can be found in the node ID index in the XML table space. Also verify that the node ID index does not contain any entries for which no matching value in the document ID column in the base table space can be found.

Any inconsistencies found are reported as errors. All remaining parts of corrupted XML documents will be deleted from the XML table space. All the associated node ID index entries for the affected XML document will be deleted and the XML column in the base table will be set to an invalid status.

When running with SHRLEVEL CHANGE, CHECK DATA operates on shadow copies of the table spaces to be checked, corresponding REPAIR statements are generated. These generated statements must be executed by the REPAIR utility to perform the mandatory actions which CHECK DATA has identified.

Two REPAIR statements are generated.

- One statement deletes the corrupted XML document and its associated node ID index entries.
- The other REPAIR statement sets the XML column in the base table to an invalid status.

Correcting XML data after running CHECK DATA

After you run the CHECK DATA utility, you might need to correct XML data.

Procedure

To correct XML data after running CHECK DATA:

Based on the CHECK DATA output, perform one of the following actions:

Problem	Action
Problem with corrupted XML data	REPAIR statements are generated to delete each corrupted XML document from the XML table space and its associated node ID index entry.
Problem with document ID index	Run generated REPAIR LOCATE TABLESPACE control statements.
Problem with node ID index	Run generated REPAIR LOCATE TABLESPACE control statements.
Problem with integrity of XML column in the base table and the node ID index	

Resetting CHECK-pending status

If a table space has a status of CHECK-pending, you can remove the CHECK-pending status by correcting the error and running a utility job. You can either rerun the CHECK DATA utility with SHRLEVEL REFERENCE specified or you can run the REPAIR utility.

Procedure

To remove CHECK-pending status by running the CHECK DATA utility, use the following approaches:

- Use the DELETE NO option if no tables contain rows that violate referential or table check constraints. If referential or table check constraint violations are found, the table space or partition is placed in CHECK-pending status.
- Use the DELETE YES option to remove all rows that violate referential or table check constraints.

Related reference:

"CHECK-pending status" on page 1105

LOB column errors

If you run CHECK DATA on a base table space that contains at least one LOB column, you might receive an error on the LOB column.

If you specify CHECK DATA AUXERROR REPORT, AUXERROR INVALIDATE, LOBERROR REPORT, or LOBERROR INVALIDATE and a LOB column check error is detected, DB2 issues a message that identifies the table, row, column, and type of error. Any additional actions depend on the option that you specify for the AUXERROR or LOBERROR parameter:

When you specify the AUXERROR REPORT or LOBERROR REPORT option
DB2 sets the base table space to the auxiliary CHECK-pending (ACHKP) status. If CHECK DATA encounters only invalid LOB columns and no other LOB column errors, the base table space is set to the auxiliary warning (AUXW) status.

When you specify the AUXERROR INVALIDATE or LOBERROR INVALIDATE option
DB2 sets the base table LOB columns that are in error to an invalid status. DB2 resets the invalid status of LOB columns that have been corrected. If any invalid LOB columns remain in the base table, DB2 sets the base table space to auxiliary warning (AUXW) status. You can use SQL to update a

LOB column that is in the AUXW status; however, any other attempt to access the column results in a -904 SQL return code.

If you run CHECK DATA AUXERROR REPORT or INVALIDATE on a base table space that contains at least one LOB column, the following errors might be reported:

Orphan LOBs

An orphan LOB column is a LOB that is found in the LOB table space but that is not referenced by the base table space. If an orphan error is the only type of error reported by CHECK DATA, the base table is considered correct.

An orphan can result from the following situations:

- You recover the base table space to a point in time prior to the insertion of the base table row.
- You recover the base table space to a point in time prior to the definition of the LOB column.
- You recover the LOB table space to a point in time prior to the deletion of a base table row.
- A base record ROWID is incorrect, which results in an orphan LOB column error message and a missing LOB column error message. The missing LOB column error message identifies the ROWID, VERSION and row in error. The missing LOB column is handled depending on the value that you specify for the AUXERROR or LOBERROR parameter.

Missing LOBs

A missing LOB column is a LOB that is referenced by the base table space but that is not in the LOB table space. A missing LOB can result from the following situations:

- You recover the LOB table space to a point in time prior to the first insertion of the LOB into the base table.
- You recover the LOB table space to a point in time when the LOB column is null or has a zero length

Out-of-synch LOBs

An out-of-synch LOB error is a LOB that is found in both the base table and the LOB table space, but the LOB in the LOB table space is at a different level. A LOB column is also out-of-synch if the base table is null or has a zero length, but the LOB is found in the LOB table space. An out-of-synch LOB can occur anytime you recover the LOB table space or the base table space to a prior point in time.

Invalid LOBs

An invalid LOB is an uncorrected LOB column error that is found by a previous execution of CHECK DATA AUXERROR INVALIDATE.

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Resetting auxiliary CHECK-pending status

A table space with LOB or XML columns can be recovered to a point in time. In this case, RECOVER TABLESPACE sets the auxiliary CHECK-pending (ACHKP) status on the table space. You can remove the auxiliary CHECK-pending status if DB2 does not find any inconsistencies.

About this task

Use one of the following actions to reset auxiliary CHECK-pending status:

Procedure

To reset auxiliary CHECK-pending status:

Take one of the following actions:

- Use the SCOPE ALL option to check all dependent tables in the specified table space. The checks include referential integrity constraints, table check constraints, and the existence of LOB and XML columns.
- Use the SCOPE PENDING option to check table spaces or partitions with CHKP status. The checks include referential integrity constraints, table check constraints, and the existence of LOB and XML columns.
- Use the SCOPE AUXONLY option to check for LOB and XML columns.

Results

If you specified the AUXERROR INVALIDATE , LOBERROR INVALIDATE or XMLERROR INVALIDATE option and DB2 finds inconsistencies, it places the table space in AUXW status.

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Termination and restart of CHECK DATA

You can terminate and restart the CHECK DATA utility.

When you terminate CHECK DATA, table spaces remain in the same CHECK-pending status as they were at the time the utility was terminated. The CHECKDAT phase places the table space in the CHECK-pending status when CHECK DATA detects an error; at the end of the phase, CHECK DATA resets the CHECK-pending status if it detects no errors. The REPORTCK phase resets the CHECK-pending status if you specify the DELETE YES option.

You can restart a CHECK DATA utility job, but it starts from the beginning again.

Related tasks:

“Restarting an online utility” on page 52

“Terminating an online utility” on page 51

Sample CHECK DATA control statements

Use sample control statements as models for developing your own CHECK DATA control statements.

Example 1: Copying violations into exception tables

The control statement specifies that the CHECK DATA utility is to check for and delete any rows that violate referential and table check constraints in table spaces DSN8D11A.DSN8S11D and DSN8D11A.DSN8S11E. CHECK DATA copies any rows that violate these constraints into the exception tables that are specified in the FOR EXCEPTION clause. For example, CHECK DATA is to copy the violations in table DSN8810.DEPT into table DSN8810.EDEPT.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU1UQ.CHK1',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSUT1   DD DSN=IUIQU1UQ.CHK3.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(8000,(200,20),,,ROUND)
//SYSERR   DD DSN=IUIQU1UQ.CHK3.SYSERR,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(6000,(20,20),,,ROUND)
//SORTOUT  DD DSN=IUIQU1UQ.CHK3.STEP1.SORTOUT,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(6000,(20,20),,,ROUND)
//SYSIN    DD *
CHECK DATA TABLESPACE DSN8D11A.DSN8S11D
           TABLESPACE DSN8D11A.DSN8S11E
     FOR EXCEPTION IN DSN8B10.DEPT        USE DSN8B10.EDEPT
                   IN DSN8B10.EMP         USE DSN8B10.EEMP
                   IN DSN8B10.PROJ        USE DSN8B10.EPROJ
                   IN DSN8B10.PROJACT     USE DSN8B10.EPROJACT
                   IN DSN8B10.EMPPROJACT  USE DSN8B10.EEPA
     DELETE YES
//*
```

Example 2: Creating an exception table for the project activity table

You can create an exception table for the project activity table by using the following SQL statements: GUPI

```
EXEC SQL
CREATE TABLE EPROJACT
   LIKE DSN8B10.PROJACT
   IN DATABASE DSN8D11A
ENDEXEC

EXEC SQL
ALTER TABLE EPROJACT
   ADD RID CHAR(4)
ENDEXEC

EXEC SQL
ALTER TABLE EPROJACT
   ADD TIME TIMESTAMP NOT NULL WITH DEFAULT
ENDEXEC
```

GUPI The first statement requires the SELECT privilege on table DSN8B10.PROJACT and the privileges that are usually required to create a table.

Table EPROJACT has the same structure as table DSN8B10.PROJACT, but it can have two extra columns. The columns in EPROJACT are:

- Its first five columns mimic the columns of the project activity table; they have exactly the same names and descriptions. Although the column names are the same, they do not need to be. However, the rest of the column attributes for the initial columns must be same as those of the table that is being checked.

- The next column, which is added by ALTER TABLE, is optional; CHECK DATA uses it as an identifier. The name "RID" is an arbitrary choice; if the table already has a column with that name, use a different name. The column description, CHAR(4), is required.
- The final timestamp column is also optional. If you define the timestamp column, a row identifier (RID) column must precede this column. You might define a permanent exception table for each table that is subject to referential or table check constraints. You can define it once and use it to hold invalid rows that CHECK DATA detects. The TIME column allows you to identify rows that were added by the most recent run of the utility.

Eventually, you correct the data in the exception tables, perhaps with an SQL UPDATE statement, and transfer the corrections to the original tables by using statements that are similar to those in the following example: GUPI

```
INSERT INTO DSN8B10.PROJACT
   SELECT PROJNO, ACTNO, ACSTAFF, ACSTDATE, ACENDATE
     FROM EPROJACT
     WHERE TIME > CURRENT TIMESTAMP - 1 DAY;
```

GUPI

Example 3: Running CHECK DATA on a table space with LOBs

Assume that table space DBIQUQ01.TPIQU01 contains LOB columns. In the following control statement, the SCOPE ALL option indicates that CHECK DATA is to check all rows in all dependent tables in table space DBIQUQ01.TPIQU01 for the following violations:

- Violations of referential constraints
- Violations of table check constraints
- Inconsistencies between the base table space and the corresponding LOB table space.

The AUXERROR INVALIDATE option indicates that if the CHECK DATA utility finds a LOB column error in this table space, it is to perform the following actions:

- Issues a warning message
- Sets the base table LOB column to an invalid status
- Sets the base table to auxiliary warning (AUXW) status

```
//STEP11   EXEC DSNUPROC,UID='IUIQU1UQ.CHK2',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSUT1   DD DSN=IUIQU1UQ.CHK2.STEP5.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=IUIQU1UQ.CHK2.STEP5.SORTOUT,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSERR   DD DSN=IUIQU1UQ.CHK2.SYSERR,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
   CHECK DATA TABLESPACE DBIQUQ01.TPIQUQ01 SCOPE ALL
         AUXERROR INVALIDATE
/*
```

Example 4: Specifying the maximum number of exceptions

The control statement specifies that the CHECK DATA utility is to check all rows in partition number 254 in table space DBNC0216.TPNC0216. The EXCEPTIONS 1 option indicates that the utility is to terminate when it finds one exception. Any exceptions are to be reported by messages only.

```
//CKDATA   EXEC DSNUPROC,UID='L450TST3.CHECK',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSERR   DD DSN=L450TST3.CHECK.STEP1.SYSERR,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(2000,(20,20),,,ROUND)
//SYSUT1   DD DSN=L450TST3.CHECK.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=L450TST3.CHECK.STEP1.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
    CHECK DATA TABLESPACE DBNC0216.TPNC0216 PART 254
              SCOPE ALL EXCEPTIONS 1
/*
```

Example 5: Running CHECK DATA SHRLEVEL CHANGE

The control statement specifies that the CHECK DATA utility is to specifies that applications can read from and write to the table space that is to be checked.

```
CHECK DATA TABLESPACE DBNI0101.TSNI010P SHRLEVEL CHANGE
```

Example 6: Checking several table spaces

To check several table spaces, you can specify more than one table space in a CHECK DATA control statement. This technique is useful for checking a complete set of referentially related table spaces. The following example shows a CHECK DATA control statement that lists more than one table space.

```
CHECK DATA
     TABLESPACE DBJM1203.TLJM1203
      TABLESPACE DBJM1203.TPJM1204
        FOR EXCEPTION IN TLJM1203.TBJM1203 USE ADMF001.EXCPT3
           IN TPJM1204.TMBJM1204 USE ADMF001.EXCPT4
    DELETE YES
```

Example 7: Checking XML columns

The control statement specifies how to include consistency checking of XML columns in a base table with the associated node ID indexes. Specify XMLSCHEMAONLY with INCLUDE XML TABLESPACES to limit the CHECK DATA scope to only XML schema validation for the XML columns.

```
CHECK DATA TABLESPACE DBNI0101.TSNI010P INCLUDE XML TABLESPACES
     SCOPE XMLSCHEMAONLY AUXONLY
```

Example 8: Running CHECK DATA on a clone table

The control statement specifies that the CHECK DATA utility is to check the clone table in the specified table space.

```
CHECK DATA TABLESPACE DBNI0101.TSNI010P CLONE SCOPE ALL
        ERRDDN SYSERR
```

Chapter 13. CHECK INDEX

The CHECK INDEX online utility tests whether indexes are consistent with the data that they index, and it issues warning messages when it finds an inconsistency.

Run the CHECK INDEX utility after a conditional restart or a point-in-time recovery on all table spaces whose indexes might not be consistent with the data.

Also run CHECK INDEX before running CHECK DATA, especially if you specify DELETE YES. Running CHECK INDEX before CHECK DATA ensures that the indexes that CHECK DATA uses are valid. When checking an auxiliary table index, CHECK INDEX verifies that each LOB is represented by an index entry, and that an index entry exists for every LOB.

Important: Inaccurate statistics for tables, table spaces, or indexes can result in a sort failure during CHECK INDEX.

Running CHECK INDEX when the index has a VARBINARY column

If you run CHECK INDEX against the index with the following characteristics, CHECK INDEX fails:

- The index was created on a VARBINARY column or a column with a distinct type that is based on a VARBINARY data type.
- The index column has the DESC attribute.

To fix the problem, alter the column data type to BINARY, and then rebuild the index.

Output

CHECK INDEX generates several messages that show whether the indexes are consistent with the data.

For unique indexes, any two null values are treated as equal values, unless the index was created with the UNIQUE WHERE NOT NULL clause. In that case, if the key is a single column, it can contain any number of null values, and CHECK INDEX does not issue an error message.

CHECK INDEX issues an error message if it finds two or more null values and the unique index was not created with the UNIQUE WHERE NOT NULL clause.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- STATS privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority

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- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute CHECK INDEX, but only on a table space in the DSNDB01 or DSNDB06 databases.

If you are using SHRLEVEL CHANGE, the user ID that invokes COPY with the CONCURRENT option must provide the necessary authority to execute the DFSMSdss ADRDSSU command. DFSMSdss will create a shadow data set with the authority of the utility batch address space. The submitter should have an RACF ALTER authority, or its equivalent, for the shadow data set.

Execution phases of CHECK INDEX

Phase Description

UTILINIT
Performs initialization

UNLOAD
Unloads data keys

SORTCHK
Sorts unloaded data keys and scans the index to validate data keys.

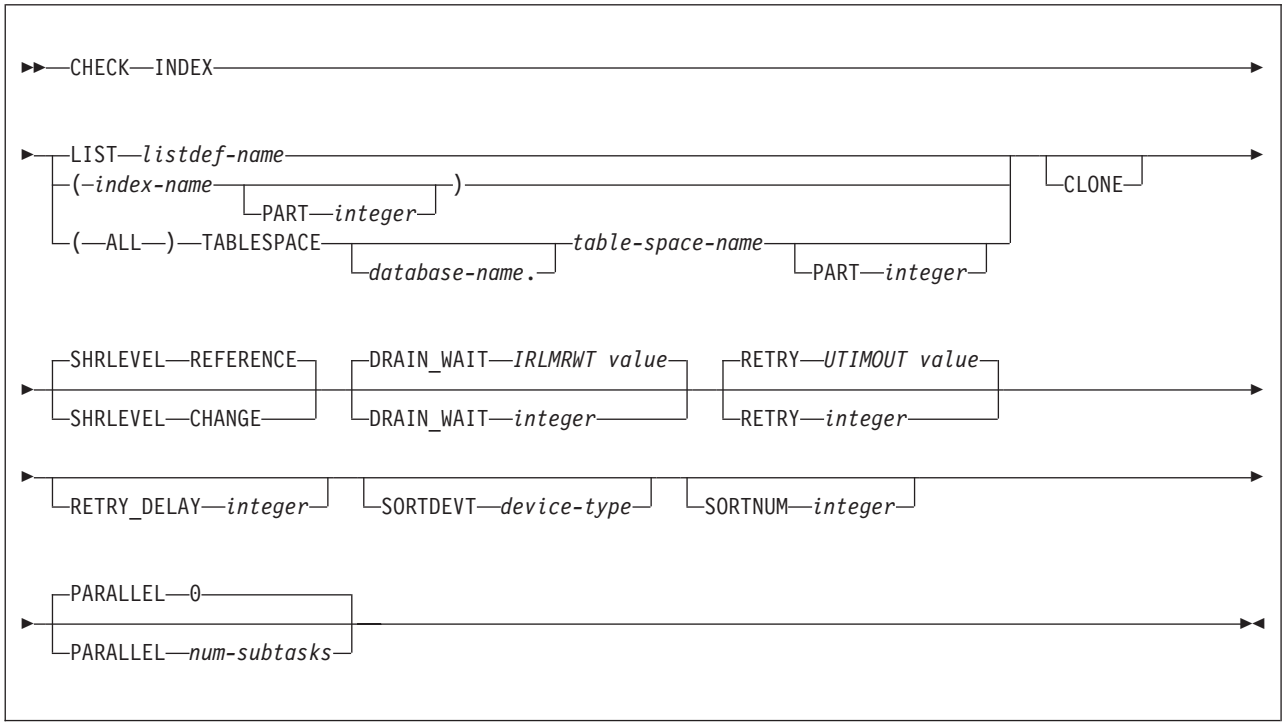
UTILTERM
Performs cleanup

Syntax and options of the CHECK INDEX control statement

The CHECK INDEX utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

INDEX
Indicates that you are checking for index consistency.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. The list must contain only index spaces. Do not specify the name of an index or of a table space. DB2 groups indexes by their related table space and executes CHECK INDEX once per table space. CHECK INDEX allows one LIST keyword for each control statement in CHECK INDEX. This utility processes clone data only if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

(*index-name***, ...)**
Specifies the indexes that are to be checked. All indexes must belong to tables in the same table space. If you omit this option, you must use the (ALL) TABLESPACE option. Then, CHECK INDEX checks all indexes on all tables in the table space that you specify.

index-name is the name of an index, in the form *creator-id.name*. If you omit the qualifier *creator-id.*, the user identifier for the utility job is used. If you use a list of names, separate items in the list by commas. Parentheses are required around a name or list of names. Enclose the index name in quotation marks if the name contains a blank.

PART *integer*
Identifies a physical partition of a partitioned index or a logical partition of a nonpartitioned index that is to be checked for consistency. If you specify an index on a nonpartitioned table space, an error occurs.

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

If the PART keyword is not specified, CHECK INDEX tests the entire target index for consistency.

(ALL)
Specifies that all indexes in the specified table space that are referenced by the table space are to be checked.

TABLESPACE *database-name.table-space-name*
Specifies the table space from which all indexes are to be checked. If an explicit list of index names is not specified, all indexes on all tables in the specified table space are checked.

Do not specify TABLESPACE with an explicit list of index names.

database-name is the name of the database that the table space belongs to. The default value is **DSNDB04**.

table-space-name is the name of the table space from which all indexes are checked.

CLONE
Indicates that CHECK INDEX is to check only the specified indexes that are on clone tables. This utility processes clone data only if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

SHRLEVEL
Indicates the type of access that is to be allowed for the index, table space, or partition that is to be checked during CHECK INDEX processing.

REFERENCE
Specifies that applications can read from but cannot write to the index, table space, or partition that is to be checked.

If you specify SHRLEVEL REFERENCE or use this value as the default, DB2 unloads the index entries, sorts the index entries, and scans the data to validate the index entries.

CHANGE
Specifies that applications can read from and write to the index, table space, or partition that is to be checked.

If you specify SHRLEVEL CHANGE, DB2 performs the following actions:

- Drains all writers and forces the buffers to disk for the specified object and all of its indexes
- Invokes DFSMSdss to copy the specified object and all of its indexes to shadow data sets
- Enables read/write access for the specified object and all of its indexes
- Runs CHECK INDEX on the shadow data sets

By default, DFSMSdss uses FlashCopy to copy DB2 objects to shadow data sets, if FlashCopy is available. If DFSMSdss cannot use FlashCopy, DFSMSdss uses a slower method. As a result, creating copies of objects might take a long time, and the time during which the data and indexes have read-only access might increase. You can set the CHECK_FASTREPLICATION subsystem parameter to REQUIRED to force the CHECK utility to use only FlashCopy. If FlashCopy is not available, the CHECK utility fails.

DRAIN_WAIT *integer*
Specifies the number of seconds that CHECK INDEX is to wait when draining the table space or index. The specified time is the aggregate time for objects that are to be checked. This value overrides the values that are specified by the IRLMRWT and UTIMOUT subsystem parameters.

integer can be any integer from 0 to 1800. If you do not specify DRAIN_WAIT or specify a value of 0, CHECK INDEX uses the value of the lock timeout subsystem parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of times that CHECK INDEX is to keep trying to drain the object.

integer can be any integer from 0 to 255. Specifying a value other than 0 can increase processing costs and result in multiple or extended periods during which the specified index, table space, or partition is in read-only access.

If you do not specify RETRY, CHECK INDEX uses the value of the utility multiplier subsystem parameter UTIMOUT.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between attempts to drain the object. *integer* can be any integer from 1 to 1800.

If you do not specify RETRY_DELAY, CHECK INDEX uses the smaller of the following two values:

- DRAIN_WAIT value × RETRY value
- DRAIN_WAIT value × 10

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by the external sort program. You can specify any disk device type that is acceptable to the DYNALLOC parameter of the SORT or OPTION control statement for the sort program.

A TEMPLATE specification does not dynamically allocate sort work data sets. The SORTDEVT keyword controls dynamic allocation of these data sets.

device-type is the device type. If you omit SORTDEVT and a sort is required, you must provide the DD statements that the sort program requires for the temporary data sets.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated by the sort program.

integer is the number of temporary data sets that can range from 2 to 255.

If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, suppose CHECK INDEX is checking three indexes, no constraints exist to limit parallelism, and you specify SORTNUM 8. In this case, a total of 24 sort work data sets are allocated for a job.

Each sort work data set consumes both above-the-line and below-the-line virtual storage. Therefore, if you specify a value for SORTNUM that is too high, the utility might decrease the degree of parallelism due to virtual storage

constraints. The degree of parallelism might possibly be decreased down to one, which means that no parallelism is used.

Important: CHECK INDEX ignores the SORTNUM keyword if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

PARALLEL *num-subtasks*

Specifies the maximum number of subtasks that are to be started in parallel to check indexes for consistency.

The value of *num-subtasks* must be an integer between 0 and 32767, inclusive. If the specified value for *num-subtasks* is greater than 32767, the CHECK INDEX statement fails. If 0 or no value is specified for *num-subtasks*, the CHECK INDEX utility uses the optimal number of parallel subtasks. If the specified value for *num-subtasks* is greater than the calculated optimal number, the CHECK INDEX utility limits the number of parallel subtasks to the optimal number with applied constraints. CHECK INDEX typically allocates subtasks in groups of two or three. Therefore, the actual number of subtasks that are started might be less than the number that is specified by the PARALLEL option.

The specified number of subtasks for PARALLEL always overrides the value of the PARAMDEG_UTIL subsystem parameter. Therefore, PARALLEL can be smaller or larger than the value of PARAMDEG_UTIL.

Related information:

"Indexes in parallel" on page 119

MAX UTILS PARALLELISM field (PARAMDEG_UTIL subsystem parameter) (DB2 Installation and Migration)

Related concepts:

"Subsystem parameters for refining DFSMSdss COPY operation with utilities" on page 48

Related reference:

Chapter 19, "LISTDEF," on page 221

DB2 Sort

Related information:

DFSORT Application Programming Guide

Data sets that CHECK INDEX uses

The CHECK INDEX utility uses a number of data sets during its operation.

The following table lists the data sets that CHECK INDEX uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 17. Data sets that CHECK INDEX uses

Data set	Description	Required?
SYSIN	An input data set that contains the utility control statement.	Yes
SYSPRINT	An output data set for messages.	Yes

Table 17. Data sets that CHECK INDEX uses (continued)

Data set	Description	Required?
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Index space
Object that is to be checked. (If you want to check only one partition of an index, use the PART option in the control statement.)

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Shadow data sets

When you execute the CHECK INDEX utility with the SHRLEVEL CHANGE option, the utility uses shadow data sets.

If a table space, partition, or index resides in DB2-managed data sets and shadow data sets do not already exist when you execute CHECK INDEX, DB2 creates the shadow data sets. At the end of CHECK INDEX processing, the DB2-managed shadow data sets are deleted.

For user-managed data sets, DFSMSdss can create or scratch and re-create the required shadow data sets as needed. When the CHECK INDEX utility completes the processing of user-managed data sets, the shadow data sets are not automatically scratched.

If you do not want the shadow data sets to be allocated in the same storage class as the production data sets, set the UTIL_TEMP_STORCLAS system parameter to specify the storage class for the shadow data sets.

Shadow data set names

Each shadow data set must have the following name:

catname.DSNDB*x*.*dbname*.*psname*.*y*000*z*.*Lnnn*

In the preceding name, the variables have the following meanings:

variable
meaning

catname
The VSAM catalog name or alias

x C or D

dbname
Database name

psname
Table space name or index name

y I or J

z 1 or 2

Lnnn Partition identifier. Use one of the following values:

- A001 through A999 for partitions 1 through 999
- B000 through B999 for partitions 1000 through 1999
- C000 through C999 for partitions 2000 through 2999
- D000 through D999 for partitions 3000 through 3999
- E000 through E996 for partitions 4000 through 4096

GUPI To determine the names of existing data sets, execute one of the following queries against the SYSTABLEPART or SYSINDEXPART catalog tables:

```
SELECT DBNAME, TSNAME, IPREFIX
   FROM SYSIBM.SYSTABLEPART
   WHERE DBNAME = 'dbname'
   AND TSNAME = 'psname';
SELECT DBNAME, IXNAME, IPREFIX
   FROM SYSIBM.SYSINDEXES X, SYSIBM.SYSINDEXPART Y
   WHERE X.NAME = Y.IXNAME
   AND X.CREATOR = Y.IXCREATOR
   AND X.DBNAME = 'dbname'
   AND X.INDEXSPACE = 'psname';
```

GUPI

Defining shadow data sets

For a partitioned table space, DB2 returns rows from which you select the row for the partitions that you want to check.

Consider the following actions when you preallocate the data sets:

- Allocate the shadow data sets according to the rules for user-managed data sets.
- Define the shadow data sets as LINEAR.
- Use SHAREOPTIONS(3,3).
- Allocate base or clone objects
- Define the shadow data sets as EA-enabled if the original table space or index space is EA-enabled.
- Allocate the shadow data sets on the volumes that are defined in the storage group for the original table space or index space.

If you specify a secondary space quantity, DB2 does not use it. Instead, DB2 uses the SECQTY value for the table space or index space.

Recommendation: Use the MODEL option, which causes the new shadow data set to be created like the original data set. This method is shown in the following example:

```
DEFINE CLUSTER +
   (NAME('catname.DSNDBC.dbname.psname.x000z.L001') +
   MODEL('catname.DSNDBC.dbname.psname.y000z.L001')) +
   DATA                                              +
   (NAME('catname.DSNDBD.dbname.psname.x000z.L001') +
   MODEL('catname.DSNDBD.dbname.psname.y000z.L001') )
```

Creating shadow data sets for indexes

When you preallocate shadow data sets for indexes, create the data sets as follows:

- Create shadow data sets for the partition of the table space and the corresponding partition in each partitioning index and data-partitioned secondary index.
- Create a shadow data set for logical partitions of nonpartitioned secondary indexes.

Use the same naming scheme for these index data sets as you use for other data sets that are associated with the base index, except use J0001 instead of I0001.

Estimating the size of shadow data sets

If you have not changed the value of FREEPAGE or PCTFREE, the amount of required space for a shadow data set is comparable to the amount of required space for the original data set.

Concurrency and compatibility for CHECK INDEX

The CHECK INDEX utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims and drains

The following table shows which claim classes CHECK INDEX claims and drains and any restrictive state that the utility sets on the target object.

Table 18. Claim classes of CHECK INDEX operations

Target	CHECK INDEX SHRLEVEL REFERENCE	CHECK INDEX PART SHRLEVEL REFERENCE	CHECK INDEX SHRLEVEL CHANGE	CHECK INDEX PART SHRLEVEL CHANGE
Table space or partition	DW/UTRO	DW/UTRO	DW/UTRW	DW/UTRW
Partitioning index or index partition	DW/UTRO	DW/UTRO	DW/UTRW	DW/UTRW
Secondary index[1]	DW/UTRO	none	DW/UTRW	DW/UTRW
Data-partitioned secondary index or index partition[2]	DW/UTRO	DW/UTRO	DW/UTRW	DW/UTRW
Logical partition of an index	none	DW/UTRO	DW/UTRW	DW/UTRW

Table 18. Claim classes of CHECK INDEX operations (continued)

Target	CHECK INDEX SHRLEVEL REFERENCE	CHECK INDEX PART SHRLEVEL REFERENCE	CHECK INDEX SHRLEVEL CHANGE	CHECK INDEX PART SHRLEVEL CHANGE

Legend:
- DW: Drain the write claim class, concurrent access for SQL readers
- UTRO: Utility restrictive state, read only-access allowed
- UTRW: Utility restrictive state, read and write access allowed
- none: Object not affected by this utility

Note:

1. Includes document ID indexes and node ID indexes over non-partitioned XML table spaces and XML indexes.
2. Includes document ID indexes and node ID indexes over partitioned XML table spaces.

CHECK INDEX does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

CHECK INDEX of an XML index cannot run if REBUILD INDEX, REORG INDEX, or RECOVER is being run on that index because CHECK INDEX needs access to the node ID index. CHECK INDEX SHRLEVEL CHANGE cannot run two jobs concurrently for two different indexes that are in the same table space or partition because the snapshot shadow will have a conflicting name for the table space.

Compatibility

The following table shows which utilities can run concurrently with CHECK INDEX on the same target object. The first column lists the other utility and the second column lists whether or not that utility is compatible with CHECK INDEX. The target object can be a table space, an index space, or an index partition. If compatibility depends on particular options of a utility, that information is also documented in the table.

Table 19. Compatibility of CHECK INDEX SHRLEVEL REFERENCE with other utilities

Action	Compatible with CHECK INDEX?
CHECK DATA	No
CHECK INDEX.	Yes
CHECK LOB	Yes
COPY INDEXSPACE	Yes
COPY TABLESPACE	Yes
DIAGNOSE	Yes
LOAD	No
MERGECOPY	Yes
MODIFY	Yes
QUIESCE	Yes
REBUILD INDEX	No
RECOVER INDEX	No
RECOVER TABLESPACE	No

Table 19. Compatibility of CHECK INDEX SHRLEVEL REFERENCE with other utilities (continued)

Action	Compatible with CHECK INDEX?
REORG INDEX	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes
REPAIR DELETE or REPLACE	No
REPAIR DUMP or VERIFY	Yes
REPORT	Yes
RUNSTATS	Yes
STOSPACE	Yes
UNLOAD	Yes

To run on SYSIBM.DSNLUX01 or SYSIBM.DSNLUX02, CHECK INDEX must be the only utility within the job step.

Single logical partitions

You can run CHECK INDEX on a single logical partition of a secondary index. However, what CHECK INDEX can detect is limited.

- CHECK INDEX does not detect duplicate unique keys in different logical partitions. For example, logical partition 1 might have the following keys:

  ```
  A  B  E  F  T  Z
  ```

  Logical partition 2 might have the following keys:

  ```
  M  N  Q  T  V  X
  ```

  In this example, the keys are unique within each logical partition, but both logical partitions contain the key, T; so for the index as a whole, the keys are not unique. CHECK INDEX does not detect the duplicates.
- CHECK INDEX does not detect keys that are out of sequence between different logical partitions. For example, the following keys are out of sequence:

  ```
  1  7  5  8  9  10  12
  ```

  If keys 1, 5, 9, and 12 belong to logical partition 1 and keys 7, 8, and 10 belong to logical partition 2, the keys within each partition are in sequence, but the keys for the index, as a whole, are out of sequence, as shown in the following example:

  ```
  LP 1   1     5     9      12 LP 2   7     8     10
  ```

  When checking a single logical partition, CHECK INDEX does not detect this out-of-sequence condition.

Indexes in parallel

If you specify more than one index, CHECK INDEX checks the indexes in parallel unless they are constrained by available memory, sort work files, or the PARALLEL option. Sorting the index keys and checking multiple indexes in parallel, rather than sequentially, reduces the elapsed time for a CHECK INDEX job.

If you do not specify the PARALLEL option, the PARAMDEG_UTIL subsystem parameter determines the maximum degree of parallelism for the utility.

The following figure shows the flow of a CHECK INDEX job with a parallel index check for a nonpartitioned table space or a single partition of a partitioned table space.

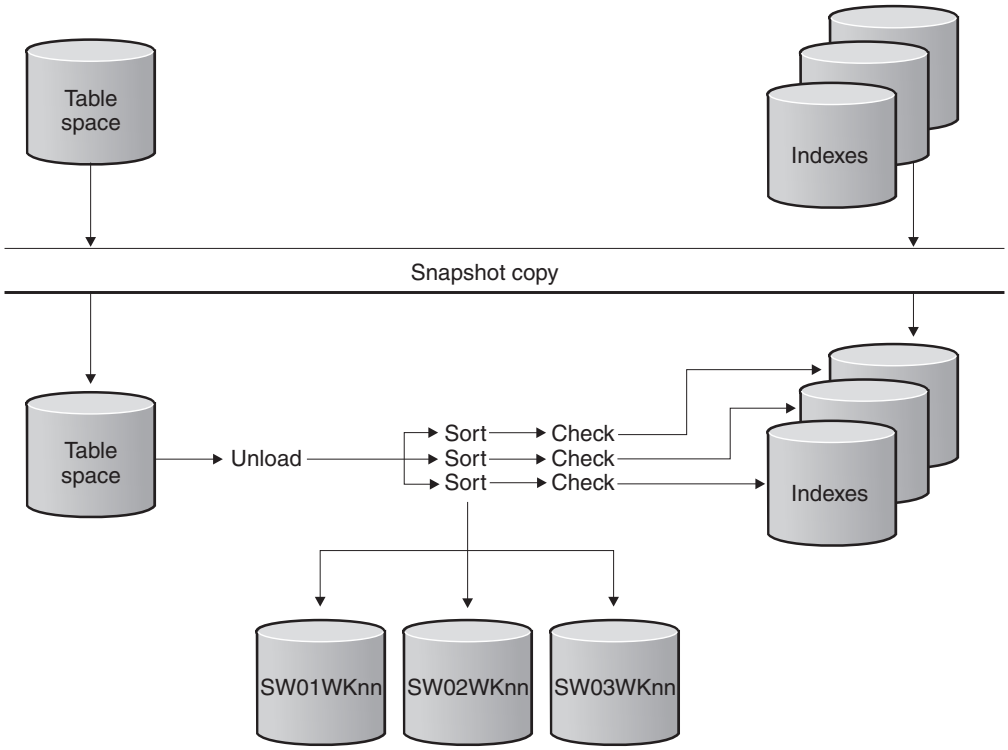


Figure 9. Parallel index check for a nonpartitioned table space or a single partition of a partitioned table space

The following figure shows the flow of a CHECK INDEX job with a parallel index check for all partitioning indexes on a partitioned table space.

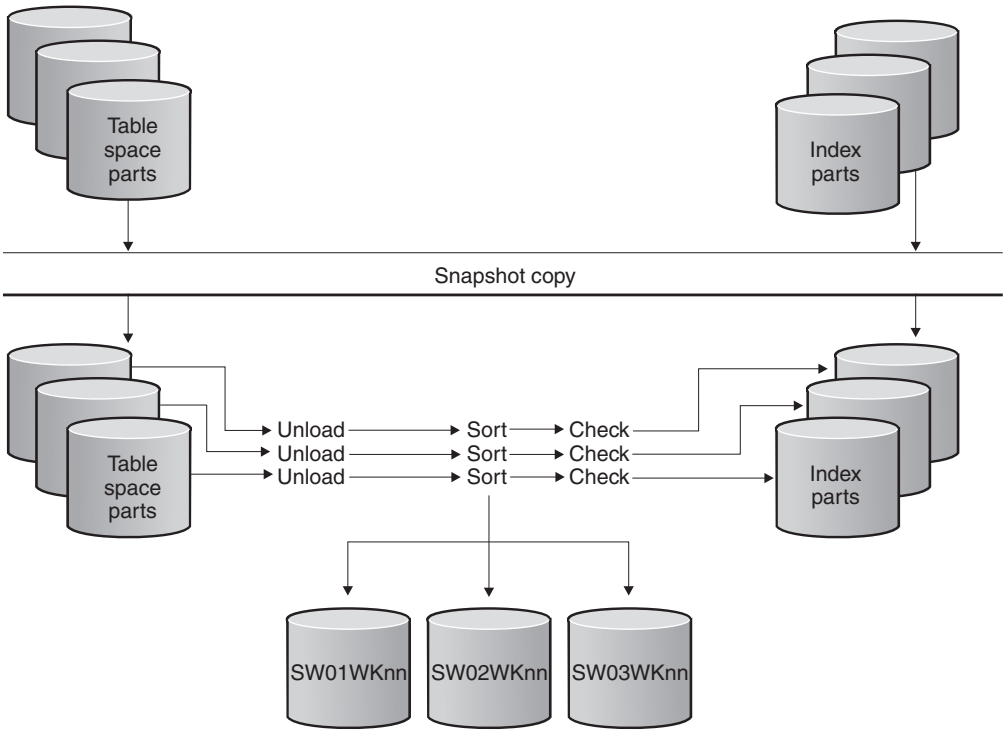


Figure 10. Parallel index check for all partitioning indexes on a partitioned table space

The following figure shows the flow of a CHECK INDEX job with a parallel index check for a partitioned table space with a single nonpartitioned secondary index.

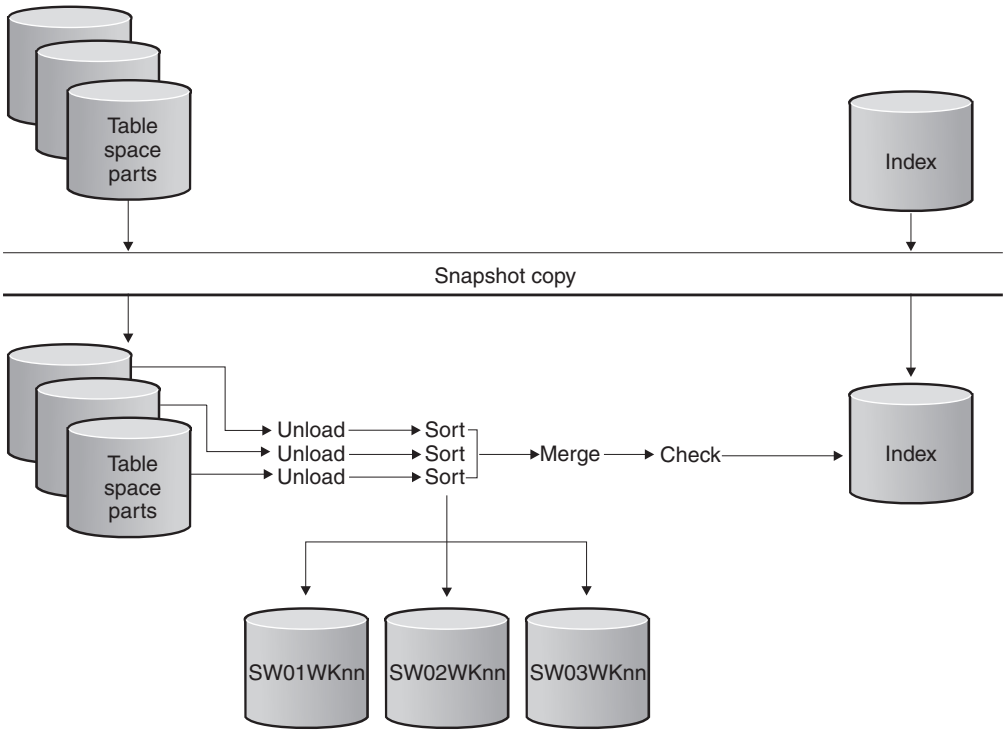


Figure 11. Parallel index check for a partitioned table space with a single nonpartitioned secondary index

The following figure shows the flow of a CHECK INDEX job with a parallel index check for all indexes on a partitioned table space. Each unload task pipes keys to each sort task, sorting the keys and piping them back to the check tasks.

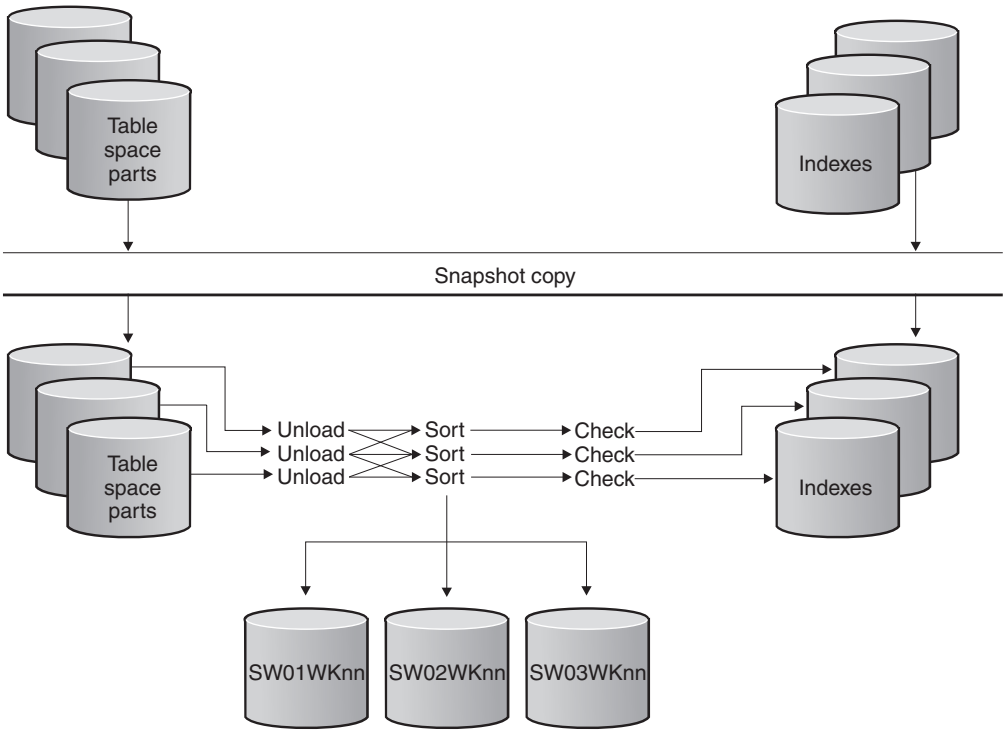


Figure 12. Parallel index check for all indexes on a partitioned table space

Reviewing CHECK INDEX output

CHECK INDEX indicates whether a table space and its indexes are inconsistent, but it does not correct any such inconsistencies. If CHECK INDEX detects inconsistencies, you should analyze the output to determine the problem and then correct the inconsistency.

Procedure

To identify the inconsistency:

1. Examine the error messages that CHECK INDEX issues.
2. Verify the point in time for each object that is recovered. Use output from REPORT RECOVERY to ensure that the table space and indexes are recovered to the same point in time. If you specify TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY, ensure that the point in time is a SHRLEVEL REFERENCE copy.
3. If the table space is correct, run the REBUILD INDEX utility to rebuild the indexes.
4. If the index is correct, determine a consistent point in time for the table space, and run the RECOVER utility on the table space. Run CHECK INDEX again to verify consistency.
5. If neither the table space nor its indexes are correct, determine a point in time to which to recover both the table space and indexes, and then rerun the RECOVER utility job, including the table space and its indexes all in the same list.

Related concepts:

How to report recovery information (DB2 Administration Guide)

Related reference:

Chapter 26, "REBUILD INDEX," on page 427

Chapter 27, "RECOVER," on page 457

Chapter 31, "REPORT," on page 693

Termination or restart of CHECK INDEX

You can terminate and restart the CHECK INDEX utility.

You can terminate CHECK INDEX in any phase without any integrity exposure.

You can restart a CHECK INDEX utility job, but it starts from the beginning again.

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

Correcting XML data after running CHECK INDEX

After you run the CHECK INDEX utility, you might need to correct XML data.

Procedure

To correct XML data:

Based on the CHECK INDEX output, perform one of the following actions:

Problem	Action
Problem with a document ID index	1. Confirm that the base table space is at the correct level. 2. Rebuild the index.
Problem with an XML table space for a node ID index or an XML index and the index is correct	Run REPAIR LOCATE RID DELETE to remove the orphan row.
Problem with an XML table space for a node ID index or an XML index and the index is incorrect	Run REBUILD INDEX or RECOVER INDEX to rebuild the index.
Problem with an XML index over an XML table space	Run REBUILD INDEX to rebuild the index. **Restriction:** Do not run REPAIR LOCATE RID DELETE to remove orphan rows unless the node ID index does not represent the same row and the base table space does not use the document ID index.

Sample CHECK INDEX control statements

Sample control statements are helpful as models for developing your own CHECK INDEX control statements.

Example 1: Checking all indexes

The control statement specifies that the CHECK INDEX utility is to check all indexes in sample table space DSN8D81A.DSN8S81E.

```
//STEP1   EXEC DSNUPROC,UID='IUIQU1UQ.CHK1',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSERR   DD DSN=IUIQU1UQ.CHK3.SYSERR,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(6000,(20,20),,,ROUND)
//SORTOUT  DD DSN=IUIQU1UQ.CHK3.STEP1.SORTOUT,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(6000,(20,20),,,ROUND)
//SYSIN    DD *
CHECK INDEX (ALL) TABLESPACE DSN8D11A.DSN8S11E
//*
```

Example 2: Checking one index

The following control statement specifies that the CHECK INDEX utility is to check the project-number index (DSN8B10.XPROJ1) on the sample project table. SORTDEVT SYSDA specifies that SYSDA is the device type for temporary data sets that are to be dynamically allocated by the sort program.

```
CHECK INDEX (DSN8B10.XPROJ1)
  SORTDEVT SYSDA
```

Example 3: Checking more than one index

The following control statement specifies that the CHECK INDEX utility is to check the indexes DSN8B10.XEMPRAC1 and DSN8B10.XEMPRAC2 on the employee-to-project-activity sample table.

```
CHECK INDEX NAME (DSN8B10.XEMPRAC1, DSN8B10.XEMPRAC2)
```

Example 4: Checking partitions of all indexes

In the following control statement, table space DB0S0301.TP0S0301 has one partitioned index (ADMF001.IP0S0301), one data-partitioned secondary index (ADMF001.ID0S0302), and one nonpartitioned secondary index (ADMF001.IX0S0303). The (ALL) option indicates that all three indexes on the table space are to be checked. PART 3 indicates that CHECK INDEX is to check the third physical partition of any partitioned indexes and the third logical partition of any nonpartitioned indexes.

```
CHECK INDEX(ALL) TABLESPACE DBOS0301.TPOS0301 PART 3 SORTDEVT SYSDA
```

In this case, CHECK INDEX checks the third physical partition of ADMF001.IP0S0301, the third physical partition of ADMF001.ID0S0302, and the third logical partition of ADMF001.IX0S0303, as indicated by the following output.

```
DSNU050I  DSNUGUTC- CHECK INDEX(ALL) TABLESPACE DBOS0301.TPOS0301 PART 3 SORTDEVT SYSDA
DSNU700I= DSNUKGET- 10 INDEX ENTRIES UNLOADED FROM INDEX='ADMF001.IPOS0301' PARTITION=3
DSNU700I= DSNUKGET- 10 INDEX ENTRIES UNLOADED FROM INDEX='ADMF001.IDOS0302' PARTITION=3
DSNU701I= DSNUKGET- 10 INDEX ENTRIES UNLOADED FROM 'ADMF001.IXOS0303'
DSNU705I  DSNUK001- UNLOAD PHASE COMPLETE - ELAPSED TIME=00:00:00
DSNU717I= DSNUKTER- 10 ENTRIES CHECKED FOR INDEX 'ADMF001.IPOS0301' PARTITION=3
DSNU717I= DSNUKTER- 10 ENTRIES CHECKED FOR INDEX 'ADMF001.IDOS0302' PARTITION=3
DSNU717I= DSNUKTER- 10 ENTRIES CHECKED FOR INDEX 'ADMF001.IXOS0303' PARTITION=3
DSNU720I  DSNUK001- CHECKIDX PHASE COMPLETE, ELAPSED TIME=00:00:00
DSNU010I  DSNUGBAC- UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 13. CHECK INDEX output from a job that checks the third partition of all indexes.

Example 5: Checking indexes in a list

The LISTDEF control statement defines a list of indexes called CHKIDXB_LIST. The CHECK INDEX control statement specifies that CHECK INDEX is to check all indexes that are included in the CHKIDXB_LIST list. SORTDEVT SYSDA specifies that SYSDA is the device type for temporary data sets that are to be dynamically allocated by the sort program. SORTNUM 4 specifies that four of these data sets are to be dynamically allocated.

```
//CHKIDXB EXEC PGM=DSNUTILB,REGION=4096K,PARM='SSTR,CHKINDX1'
//SYSPRINT DD SYSOUT=A
//SYSUDUMP DD SYSOUT=A
//UTPRINT  DD SYSOUT=A
//DSNTRACE DD SYSOUT=A
//SYSOUT   DD UNIT=SYSDA,SPACE=(CYL,(5,2)),VOL=SER=SCR03
//SORTLIB  DD DISP=SHR,DSN=SYS1.SORTLIB
//SORTOUT  DD UNIT=SYSDA,SPACE=(CYL,(5,2)),VOL=SER=SCR03
//SYSERR   DD UNIT=SYSDA,SPACE=(CYL,(5,2)),VOL=SER=SCR03
//SYSIN    DD *
LISTDEF CHKIDXB_LIST INCLUDE INDEXSPACE DBOT55*.* ALL
CHECK INDEX LIST CHKIDXB_LIST
                 SORTDEVT SYSDA
                 SORTNUM 4
/*
```

Figure 14. Example of checking indexes in a list

Example 6: Checking all specified indexes on clone tables

The following control statement specifies that the CHECK INDEX utility is to check all specified indexes that are on clone tables.

```
CHECK INDEX (ALL) TABLESPACE DBLOB01.TSLOBC4 CLONE
```

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Chapter 14. CHECK LOB

You can run the CHECK LOB online utility on a LOB table space to identify any structural defects in the LOB table space and any invalid LOB values.

The CHECK LOB utility is useful in a variety of circumstances:

- Run the utility on a LOB table space that is in CHECK-pending (CHKP) status to identify structural defects. If none are found, the CHECK LOB utility turns the CHKP status off.
- Run the utility on a LOB table space that is in auxiliary-warning (AUXW) status to identify invalid LOBs. If none exist, the CHECK LOB utility turns AUXW status off.
- Run the utility after a conditional restart or a point-in-time recovery on all table spaces where LOB table spaces might not be synchronized.
- Run the utility before you run the CHECK DATA utility on a table space that contains at least one LOB column.

Output

After successful execution, CHECK LOB SHRLEVEL CHANGE does not set or reset the CHECK-pending (CHKP) and auxiliary-warning (AUXW) statuses.

If the utility finds any inconsistencies, the LOB table space that is checked is not put into the CHECK-pending status. You can force the prior behavior, that a LOB table space is put into CHECK-pending status when inconsistencies are detected, by specifying CHECK_SETCHKP=Y on the CHECK_SETCHKP system parameter.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- STATS privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute CHECK LOB.

If you are using SHRLEVEL CHANGE, the user ID that invokes COPY with the CONCURRENT option must provide the necessary authority to execute the DFSMSdss ADRDSSU command. DFSMSdss will create a shadow data set with the authority of the utility batch address space. The submitter should have a RACF ALTER authority, or its equivalent, for the shadow data set.

Execution phases of CHECK LOB

The CHECK LOB utility operates in the following phases:

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UTILINIT
Performs initialization

CHECKLOB
Scans all active pages of the LOB table space; generates up to four records per LOB page; passes records to the SORTIN phase

SORTIN
Passes CHECKLOB phase records to SORT

SORT Sorts the records from the CHECKLOB phase

SORTOUT
Passes sorted records to the REPRTLOB phase

REPRTLOB
Examines records that are produced by the CHECKLOB phase; issues error messages

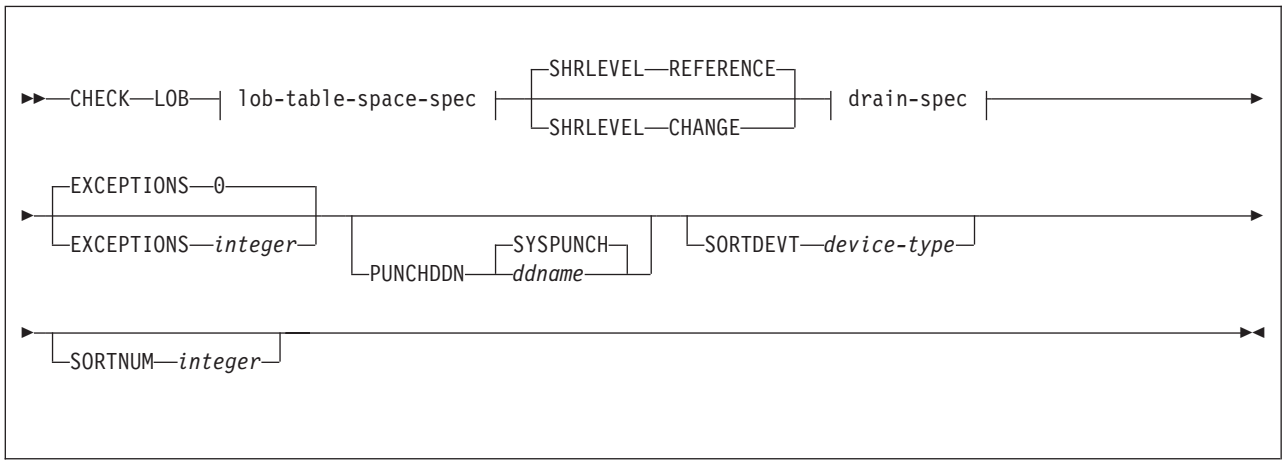
UTILTERM
Performs cleanup

Syntax and options of the CHECK LOB control statement

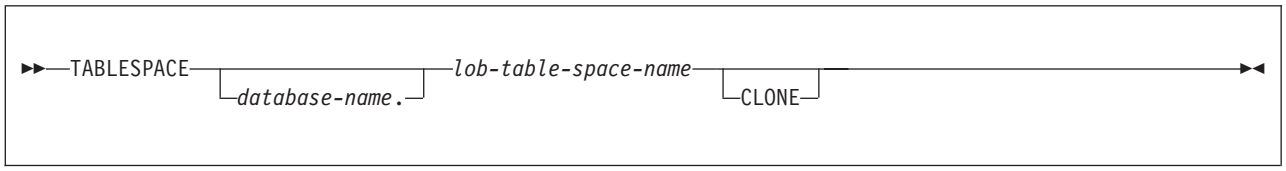
The CHECK LOB utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

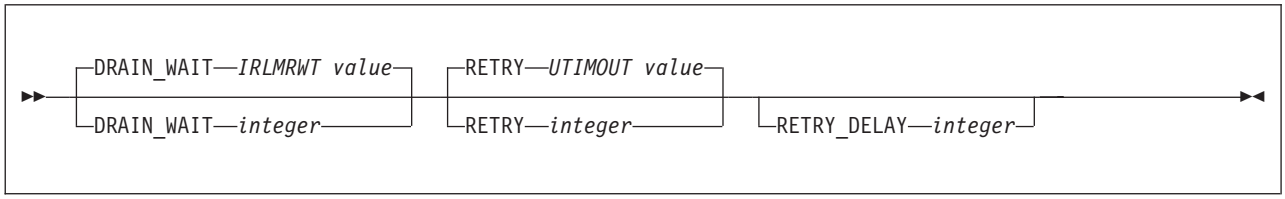
Syntax diagram



lob-table-space-spec:



drain-spec:



Option descriptions

LOB
Indicates that you are checking a LOB table space for defects.

TABLESPACE *database-name.lob-table-space-name*
Specifies the table space to which the data belongs.

database-name is the name of the database and is optional.

The default value is **DSNDB04**.

lob-table-space-name is the name of the LOB table space.

SHRLEVEL
Indicates the type of access that is to be allowed for the index, table space, or partition that is to be checked during CHECK LOB processing.

REFERENCE
Specifies that applications can read from but cannot write to the index, table space, or partition that is to be checked.

CHANGE
Specifies that applications can read from and write to the index, table space, or partition that is to be checked.

If you specify SHRLEVEL CHANGE, DB2 performs the following actions:

- Drains all writers and forces the buffers to disk for the specified object and all of its indexes
- Invokes DFSMSdss to copy the specified object and all of its indexes to shadow data sets
- Enables read-write access for the specified object and all of its indexes
- Runs CHECK INDEX on the shadow data sets

By default, DFSMSdss uses FlashCopy to copy DB2 objects to shadow data sets, if FlashCopy is available. If DFSMSdss cannot use FlashCopy, DFSMSdss uses a slower method. As a result, creating copies of objects might take a long time, and the time during which the data and indexes have read-only access might increase. You can set the CHECK_FASTREPLICATION subsystem parameter to REQUIRED to force the CHECK utility to use only FlashCopy. If FlashCopy is not available, the CHECK utility fails.

DRAIN_WAIT
Specifies the number of seconds that CHECK LOB is to wait when draining the table space or index. The specified time is the aggregate time for objects that are to be checked. This value overrides the values that are specified by the IRLMRWT and UTIMOUT subsystem parameters.

integer can be any integer from 0 to 1800. If you do not specify DRAIN_WAIT or specify a value of 0, CHECK LOB uses the value of the lock timeout subsystem parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of retries that CHECK LOB is to attempt.

integer can be any integer from 0 to 255. If you do not specify RETRY, CHECK LOB uses the value of the utility multiplier system parameter UTIMOUT.

Specifying RETRY can increase processing costs and result in multiple or extended periods during which the specified index, table space, or partition is in read-only access.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between retries. *integer* can be any integer from 1 to 1800.

If you do not specify RETRY_DELAY, CHECK LOB uses the smaller of the following two values:

- DRAIN_WAIT value × RETRY value
- DRAIN_WAIT value × 10

EXCEPTIONS *integer*
Specifies the maximum number of exceptions, which are reported by messages only. CHECK LOB terminates in the CHECKLOB phase when it reaches the specified number of exceptions.

All defects that are reported by messages are applied to the exception count.

integer is the maximum number of exceptions.

The default value is **0**, which indicates no limit on the number of exceptions.

PUNCHDDN *ddname*
Specifies the DD statement for a data set that is to receive the REPAIR utility control statements that CHECK LOB SHRLEVEL CHANGE generates. The REPAIR statements generated deletes the LOBs reported in error messages from the LOB table space. CHECK DATA should then be run against the base table space to set the deleted LOB columns in the base records to invalid.

ddname is the DD name.

The default value is **SYSPUNCH**.

The PUNCHDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a name in the current job step and a TEMPLATE name, the utility uses the DD name.

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by the sort program.

A TEMPLATE specification does not dynamically allocate sort work data sets. The SORTDEVT keyword controls dynamic allocation of these data sets.

device-type is the device type and can be any disk device type that is acceptable to the DYNALLOC parameter of the SORT or OPTION control statement for the sort program.

If you omit SORTDEVT and a sort is required, you must provide the DD statements that the sort program requires for the temporary data sets.

SORTNUM *integer*
Indicates the number of temporary data sets that are to be dynamically allocated by the sort program.

integer is the number of temporary data sets that can range from 2 to 255.

If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program, which then uses its own default. You need at least two sort work data sets for each sort.

Important: The SORTNUM keyword will not be considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

CLONE
Indicates that CHECK LOB is to check the LOB space data for only the clone table, not the LOB data for the base table.

Related concepts:

"Subsystem parameters for refining DFSMSdss COPY operation with utilities" on page 48

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Before running CHECK LOB

Certain activities might be required before you run the CHECK LOB utility, depending on your situation.

You must first recover a LOB table space that is in RECOVER-pending status before running CHECK LOB.

Beginning in Version 8, the CHECK LOB utility does not require SYSUT1 and SORTOUT data sets. Work records are written to and processed from an asynchronous SORT phase. The WORKDDN keyword, which provided the DD names of the SYSUT1 and SORTOUT data sets in earlier versions of DB2, is not needed and is ignored. You do not need to modify existing control statements to remove the WORKDDN keyword.

Data sets that CHECK LOB uses

The CHECK LOB utility uses a number of data sets during its operation.

The following table lists the data sets that CHECK LOB uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 20. Data sets that CHECK LOB uses

Data set	Description	Required?
SYSIN	An input data that contains the utility control statement.	Yes
SYSPRINT	An output data set for messages.	Yes

Table 20. Data sets that CHECK LOB uses (continued)

Data set	Description	Required?
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes

The following object is named in the utility control statement and does not require DD statements in the JCL:

Table space
Object that is to be checked.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. When you allocate sort work data sets on disk, the recommended amount of space to allow provides at least 1.2 times the amount of data that is to be sorted.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Shadow data sets

When you execute the CHECK LOB utility with the SHRLEVEL CHANGE option, the utility uses shadow data sets.

If a table space, partition, or index resides in DB2-managed data sets and shadow data sets do not already exist when you execute CHECK LOB, DB2 creates the shadow data sets. At the end of CHECK LOB processing, the DB2-managed shadow data sets are deleted.

For user-managed data sets, DFSMSdss can create or scratch and recreate the required shadow data sets as needed. When the CHECK LOB utility completes the processing of user-managed data sets, the shadow data sets are not automatically scratched.

If you have not changed the value of FREEPAGE or PCTFREE on the CREATE TABLESPACE statement, the amount of required space for a shadow data set is comparable to the amount of required space for the original data set.

If you do not want the shadow data sets to be allocated in the same storage class as the production data sets, set the UTIL_TEMP_STORCLAS system parameter to specify the storage class for the shadow data sets.

Shadow data set names

Each shadow data set must have the following name:

catname.DSNDB*x*.*dbname*.*psname*.*y*000*z*.*Lnnn*

In the preceding name, the variables have the following meanings:

variable
meaning

catname
The VSAM catalog name or alias

x C or D

dbname
Database name

psname
Table space name or index name

y I or J

z 1 or 2

Lnnn Partition identifier. Use one of the following values:

- A001 through A999 for partitions 1 through 999
- B000 through B999 for partitions 1000 through 1999
- C000 through C999 for partitions 2000 through 2999
- D000 through D999 for partitions 3000 through 3999
- E000 through E996 for partitions 4000 through 4096

To determine the names of existing data sets, execute one of the following queries against the SYSTABLEPART or SYSINDEXPART catalog tables: GUPI

```
SELECT DBNAME, TSNAME, IPREFIX
   FROM SYSIBM.SYSTABLEPART
   WHERE DBNAME = 'dbname'
    AND TSNAME = 'psname';
SELECT DBNAME, IXNAME, IPREFIX
   FROM SYSIBM.SYSINDEXES X, SYSIBM.SYSINDEXPART Y
   WHERE X.NAME = Y.IXNAME
    AND X.CREATOR = Y.IXCREATOR
    AND X.DBNAME = 'dbname'
    AND X.INDEXSPACE = 'psname';
```

GUPI

Defining shadow data sets

For a partitioned table space, DB2 returns rows from which you select the row for the partitions that you want to check.

Consider the following actions when you preallocate the data sets:

- Allocate the shadow data sets according to the rules for user-managed data sets.
- Define the shadow data sets as LINEAR.
- Use SHAREOPTIONS(3,3).
- Define the shadow data sets as EA-enabled if the original table space or index space is EA-enabled.
- Allocate the shadow data sets on the volumes that are defined in the storage group for the original table space or index space.

If you specify a secondary space quantity, DB2 does not use it. Instead, DB2 uses the SECQTY value for the table space or index space.

Recommendation: Use the MODEL option, which causes the new shadow data set to be created like the original data set. This method is shown in the following example:

```
DEFINE CLUSTER +
   (NAME('catname.DSNDBC.dbname.psname.x000z.L001') +
   MODEL('catname.DSNDBC.dbname.psname.y000z.L001')) +
   DATA +
   (NAME('catname.DSNDBD.dbname.psname.x000z.L001') +
   MODEL('catname.DSNDBD.dbname.psname.y000z.L001') )
```

Creating shadow data sets for indexes

When you preallocate shadow data sets for indexes, create the data sets as follows:

- Create shadow data sets for the partition of the table space and the corresponding partition in each partitioning index and data-partitioned secondary index.
- Create a shadow data set for logical partitions of nonpartitioned secondary indexes.

Use the same naming scheme for these index data sets as you use for other data sets that are associated with the base index, except use J0001 instead of I0001.

Concurrency and compatibility for CHECK LOB

The CHECK LOB utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims and drains

The following table shows which claim classes CHECK LOB claims and drains and any restrictive state that the utility sets on the target object.

Table 21. Claim classes for CHECK LOB operations on a LOB table space and index on the auxiliary table

Target objects	CHECK LOB SHRLEVEL REFERENCE	CHECK LOB SHRLEVEL CHANGE
LOB table space	DW/UTRO	CR/UTRW
Index on the auxiliary table	DW/UTRO	CR/UTRW

Legend:
- CR: Claim the read claim class
- DW: Drain the write claim class, concurrent access for SQL readers
- UTRO: Utility restrictive state, read-only access allowed
- UTRW: Utility restrictive state, read and write access allowed

Compatibility

Any SQL operation or other online utility that attempts to update the same LOB table space is incompatible.

How CHECK LOB identifies violations

You can find and resolve violations by reviewing messages that the CHECK LOB utility issues.

CHECK LOB issues message DSNU743I whenever it finds a LOB value that is invalid. The violation is identified by the row ID and version number of the LOB. You can resolve LOB violations by using the UPDATE or DELETE SQL statements to update the LOB column or delete the row that is associated with the LOB. (Use the row ID from message DSNU743I.)

Contact IBM Software Support for assistance with diagnosing and resolving the problem.

Related reference:

DELETE (DB2 SQL)

UPDATE (DB2 SQL)

Removing CHECK-pending status for a LOB table space

If a LOB table space has a status of CHECK-pending, you can remove the CHECK-pending status by correcting the error and either rerunning the CHECK LOB utility with SHRLEVEL REFERENCE specified or by running the REPAIR utility.

About this task

Note: The CHECK LOB utility sets or resets the CHECK-pending status when errors are found only if YES is specified on the CHECK_SETCHKP subsystem parameter in the DSN6SPRM macro. The default value for CHECK_SETCHKP is NO.

Procedure

To remove CHECK-pending status:

1. Correct any defects that are found in the LOB table space by using the REPAIR utility.

   Attention: Use the REPAIR utility with care because improper use can further damage the data. If necessary, contact IBM Software Support for guidance on using the REPAIR utility.
2. Run CHECK LOB again, or run the REPAIR utility to reset CHECK-pending or auxiliary-warning status.

Related reference:

"Syntax and options of the CHECK LOB control statement" on page 128

Chapter 30, "REPAIR," on page 663

SET CHECK PENDING field (CHECK_SETCHKP subsystem parameter) (DB2 Installation and Migration)

"CHECK-pending status" on page 1105

Resolving media failure

Some media failures leave LOB pages in the logical page list (LPL), which requires action.

Procedure

To resolve media failure:

Run CHECK LOB on a LOB table space. The pages that were in the LPL are removed from the list so that they are available.

Related tasks:

Displaying the logical page list (DB2 Administration Guide)

Termination or restart of CHECK LOB

You can terminate and restart the CHECK LOB utility.

If you terminate CHECK LOB during the CHECKLOB phase, LOB table spaces remain in CHECK-pending status. During normal execution, the CHECKLOB phase places the LOB table space in CHECK-pending status; at the end of the phase, the CHECK-pending status is reset if no errors are detected.

You can restart a CHECK LOB utility job, but it starts from the beginning again.

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

Sample CHECK LOB control statements

Sample control statements are helpful as models for developing your own CHECK LOB control statements.

Example 1: Checking a LOB table space

The following control statement specifies that the CHECK LOB utility is to check LOB table space DBIQUG01.TLIQUG02 for structural defects or invalid LOB values. The EXCEPTIONS 3 option indicates that the CHECK LOB utility is to terminate when it finds three exceptions. The SORTDEVT and SORTNUM options provide information about temporary data sets that are to be dynamically allocated by the sort program. SORTDEVT SYSDA specifies that the device type is SYSDA, and SORTNUM 4 indicates that four temporary data sets are to be dynamically allocated by the sort program.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UG.CHECKL',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
CHECK LOB TABLESPACE DBIQUG01.TLIQUG02
      EXCEPTIONS 3 SORTDEVT SYSDA
      SORTNUM 4
```

Example 2: Checking the LOB table space data

The following control statement specifies that the CHECK LOB utility is to check the LOB table space data with the SHRLEVEL CHANGE option, which specifies that the application can read from and write to the table space that is to be checked.

```
//STEP2 EXEC DSNUPROC,
// UTPROC='',SYSTEM='SSTR',
// UID='CHKLOB12.STEP2'
```

```
//*SYSPUNCH DD DN=PUNCHS,DISP=(NEW,DELETE,DELETE),UNITE=SYSDA,
//*   SPACE=(CYL,(1,1)),VOL=SER=SCR03
//SYSPRINT DD SYSOUT=*
//UTPRINT DD DUMMY
//SYSIN  DD *
  CHECK LOB TABLESPACE
  DABA12.TSL12
  SHRLEVEL CHANGE
  EXCEPTIONS 5
/*
```

Example 3: Checking the LOB space data for a clone table

The following control statement specifies that the CHECK LOB utility is to check the LOB space data for only the clone table, not the LOB data for the base table. The EXCEPTIONS 0 option indicates that there is no limit on the number of exceptions. The SORTDEVT and SORTNUM options provide information about temporary data sets that are to be dynamically allocated by the sort program. SORTDEVT SYSDA specifies that the device type is SYSDA, and SORTNUM 10 indicates that ten temporary data sets are to be dynamically allocated by the sort program.

```
CHECK LOB TABLESPACE DBLOB01.TSLOBB1  CLONE
        EXCEPTIONS 0
        SORTDEVT SYSDA
        SORTNUM 10
```

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Chapter 15. COPY

The COPY online utility creates copies of certain objects.

The COPY online utility creates up to five image copies, four sequential image copies, and one FlashCopy image of any of the following objects:

- Table space
- Table space partition
- Data set of a nonpartitioned table space
- Index space
- Index space partition

The two types of image copies are:

1. A *full image copy*, which is a copy of all pages in a table space, partition, data set, or index space.
2. An *incremental image copy*, which is a copy only of those data pages that have been modified since the last use of the COPY utility and system pages.

The RECOVER utility uses these copies when recovering a table space or index space to the most recent time or to a previous time. Copies can also be used by the MERGECOPY, COPYTOCOPY, and UNLOAD utilities.

You can copy a list of objects in parallel to improve performance. Specifying a list of objects along with the SHRLEVEL REFERENCE option creates a single recovery point for that list of objects. Specifying the PARALLEL keyword allows you to copy a list of objects in parallel, rather than serially.

To calculate the number of threads you need when you specify the PARALLEL keyword, use the formula (n * 2 + 1), where n is the number of objects that are to be processed in parallel, regardless of the total number of objects in the list. If you do not use the PARALLEL keyword, n is one and COPY uses three threads for a single-object COPY job.

Output

Output from the COPY utility consists of:

- Up to four sequential data sets containing the image copy and one FlashCopy image copy.
- Rows in the SYSIBM.SYSCOPY catalog table that describe the image copy data sets that are available to the RECOVER utility. Your installation is responsible for ensuring that these data sets are available if the RECOVER utility requests them.
- If you specify the CHANGELIMIT option, a report on the change status of the table space.

The COPY-pending status is set off for table spaces if the copy was a full image copy. However, DB2 does not reset the COPY-pending status if you copy a single piece of a multi-piece linear data set. If you copy a single table space partition, DB2 resets the COPY-pending status only for the copied partition and not for the whole table space. DB2 resets the informational COPY-pending (ICOPY) status

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after you copy an index space or index. The COPY utility will reset ICOPY-pending status for not logged table spaces.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- IMAGCOPY privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute COPY, but only on a table space in the DSNDB01 or DSNDB06 database.

If the CONCURRENT option is specified, the user ID that invokes the COPY utility must have the authority to execute the DFSMSdss DUMP command.

If either the FLASHCOPY YES or FLASHCOPY CONSISTENT option is specified, the user ID that invokes the COPY utility must have the authority to execute the DFSMSdss COPY command.

Restrictions on running COPY

- COPY cannot be run on a table space during the period after RECOVER is run to a point in time before materialization of pending definition changes and before REORG is run to complete the point-in-time recovery process.

Execution phases of COPY

The COPY utility operates in these phases:

UTILINIT
Performs initialization and setup.

REPORT
Reports for CHANGELIMIT option.

COPY Creates copies.

If FLASHCOPY YES or FLASHCOPY CONSISTENT is specified, then the FlashCopy image copies are created in this phase. If FLASHCOPY is not specified, then sequential format image copies are created.

SEQCOPY
Creates additional sequential format image copies from a FlashCopy image copy when either FLASHCOPY YES or CONSISTENT is specified. The utility execution includes this phase only when both FlashCopy image copies and sequential format image copies are requested.

LOGAPPLY
Log apply identifies the most recent checkpoint for each member. All objects that are being copied will be updated to the same logpoint in order to prepare for backout processing.

If COPY SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, log apply applies the updates to the FlashCopy image copy to ensure that all activity is reflected up to the point of consistency.

LOGCSR
Log apply is called to do the current status rebuild.

If COPY SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, the LOGCSR phase identifies any uncommitted work to back out from the FlashCopy image copy.

LOGUNDO
Uncommitted work is backed out from the image copy in order to make it consistent.

If COPY SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, the LOGUNDO phase backs out uncommitted work from the FlashCopy image copy.

UTILTERM
Performs cleanup.

Related concepts:

"How to use inline copy with REORG TABLESPACE" on page 629

Related tasks:

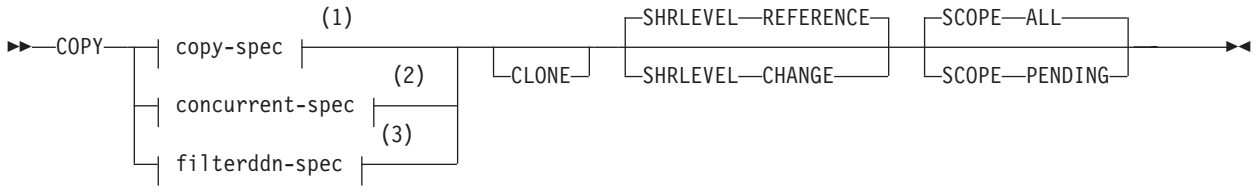
"How to use inline COPY with LOAD" on page 332

Syntax and options of the COPY control statement

The COPY utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



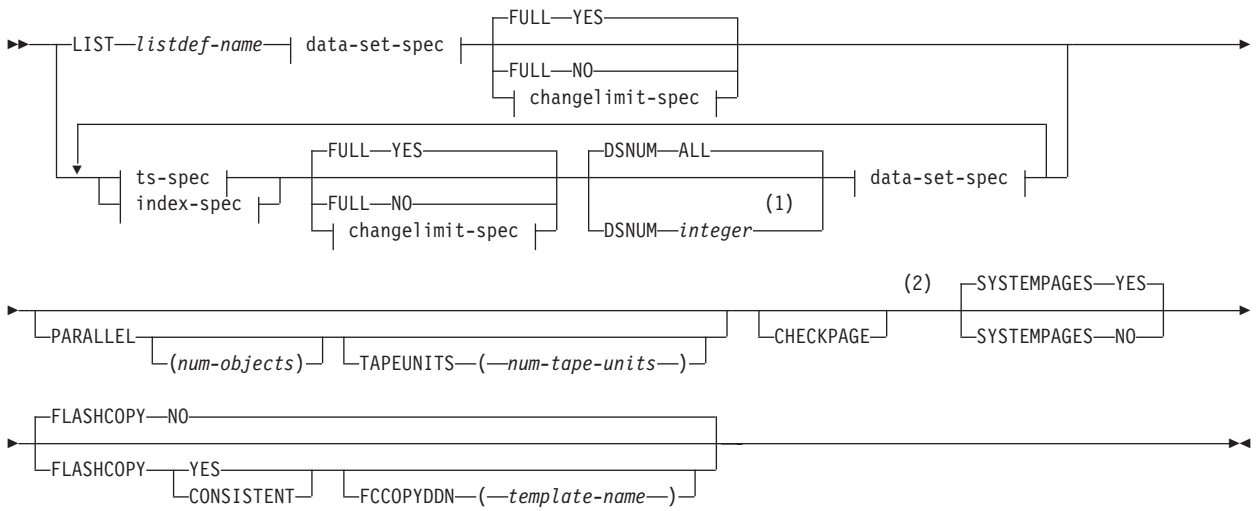
Notes:

1 Use the copy-spec if you do not want to use the CONCURRENT option.

2 Use the concurrent-spec if you want to use the CONCURRENT option, but not the FILTERDDN option.

3 Use the filterddn spec if you want to use the CONCURRENT and FILTERDDN options.

copy-spec:

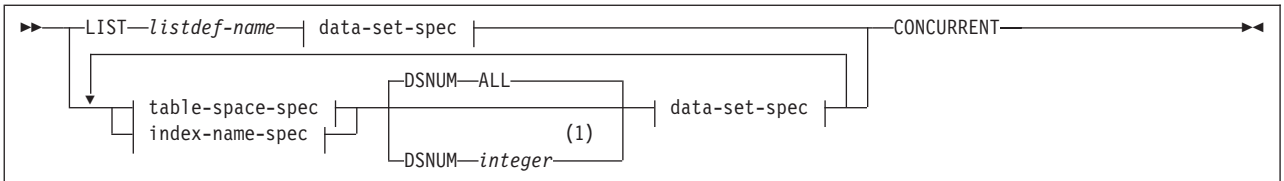


Notes:

1 Not valid for nonpartioning indexes.

2 CHECKPAGE is the default for table spaces.

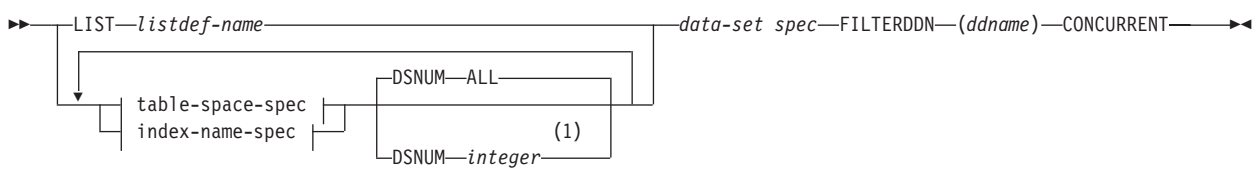
concurrent-spec:



Notes:

1 Not valid for nonpartioning indexes.

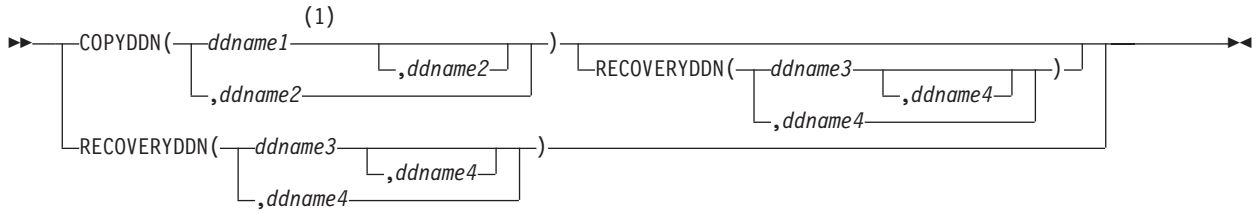
filterddn-spec:



Notes:

1 Not valid for nonpartioning indexes.

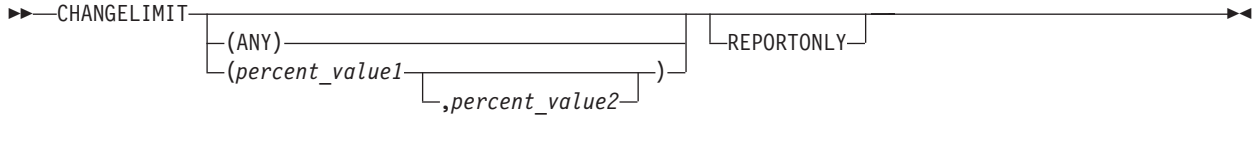
data-set-spec:



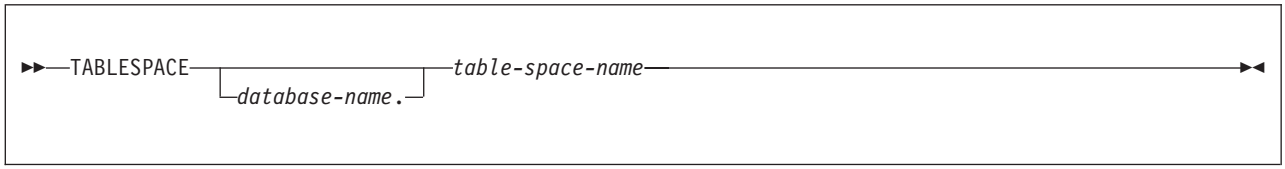
Notes:

1 COPYDDN SYSCOPY is the default for the primary copy, but this default can only be used for one object in the list.

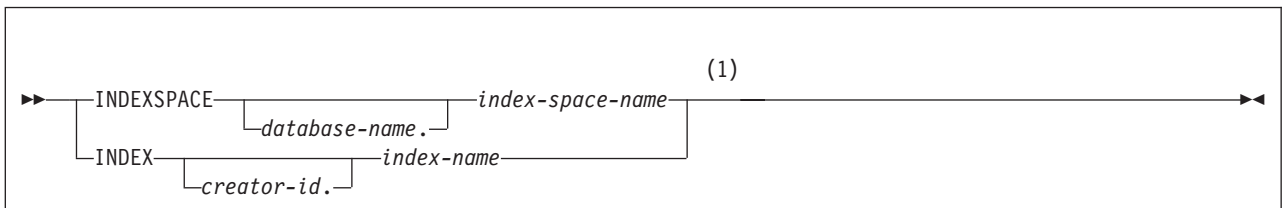
changelimit-spec:



ts-spec:



index-spec:



Notes:

1 INDEXSPACE is the preferred specification.

Option descriptions

LIST *listdef-name*

Specifies the name of a previously defined LISTDEF list name. LIST specifies one LIST keyword for each COPY control statement. Do not specify LIST with either the INDEX or the TABLESPACE keyword. DB2 invokes COPY once for the entire list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*

Specifies the table space (and, optionally, the database it belongs to) that is to be copied.

database-name is the name of the database that the table space belongs to. The **default** value is **DSNDB04**.

table-space-name is the name of the table space to be copied.

Specify the DSNDB01.SYSUTILX, DSNDB06.SYSTSCPY, or DSNDB01.SYSLGRNX table space by itself in a single COPY statement. Alternatively, specify the DSNDB01.SYSUTILX, DSNDB06.SYSTSCPY, or DSNDB01.SYSLGRNX table space with indexes over the table space that were defined with the COPY YES attribute.

If you specify a segmented table space, COPY locates empty and unformatted data pages in the table space and does not copy them.

You cannot copy a table space that uses a storage group that is defined with a mixture of specific and non-specific volume IDs.

CLONE

Indicates that COPY is to copy only clone table or index data. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

If the utility is processing a table space and CLONE is specified, the utility will only process clone table data. If the utility is processing an index and CLONE is specified, the utility will only process indexes over clone tables. If you use the LIST keyword to specify a list of objects, COPY processes only those objects in the list that contain clone tables or indexes on clone tables. COPY ignores other objects in the list.

INDEXSPACE *database-name.index-space-name*
Specifies the qualified name of the index space that is to be copied; the name is obtained from the SYSIBM.SYSINDEXES table. The specified index space must be defined with the COPY YES attribute.

database-name Optionally specifies the name of the database that the index space belongs to. The **default** value is **DSNDB04**.

index-space-name specifies the name of the index space that is to be copied.

You cannot copy an index space that uses a storage group that is defined with mixture of specific and non-specific volume IDs.

INDEX *creator-id.index-name*
Specifies the index that is to be copied. Enclose the index name in quotation marks if the name contains a blank.

creator-id optionally specifies the creator of the index. The **default** value is the user identifier for the utility.

index-name specifies the name of the index that is to be copied.

COPYDDN (*ddname1,ddname2***)**
Specifies a DD name or a TEMPLATE name for the primary (*ddname1*) and backup (*ddname2*) copy data sets for the image copy at the local site.

You can use the **COPYDDN** keyword to specify either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name. For more information about TEMPLATE specifications, see Chapter 35, "TEMPLATE," on page 789.

ddname is the DD name. The **default** value is **SYSCOPY** for the primary copy. You can use the default for only one object in the list. The first object in the list that does not have COPYDDN specified uses the default. Any other objects in the list that do not have COPYDDN specified cause an error.

If you use the CHANGELIMIT REPORTONLY option, you can use a DD DUMMY statement when you specify the SYSCOPY output data set. This card prevents a data set from being allocated and opened.

Recommendation: Catalog all of your image copy data sets.

You cannot have duplicate image copy data sets. If the DD statement identifies a noncataloged data set with the same name, volume serial, and file sequence number as one that is already recorded in the SYSIBM.SYSCOPY catalog table, the COPY utility issues a message and does not make an image copy. If COPY identifies a cataloged data set with only the same name, it does not make an image copy. For cataloged image copy data sets, CATLG must be specified for the normal termination disposition in the DD statement, as shown in the following example:

```
DISP=(MOD,CATLG,CATLG)
```

The DSVOLSER field of the SYSCOPY entry is blank.

If you use the CONCURRENT and FILTERDDN options, ensure that the size of the copy data set is large enough to include all of the objects in the list.

RECOVERYDDN (*ddname3***,***ddname4***)**
Specifies a DD name or a template name for the primary (*ddname3*) and backup (*ddname4*) copy data sets for the image copy at the recovery site.

You can use the **RECOVERYDDN** keyword to specify either a DD name or a template name. If utility processing detects that the specified name is both a DD name in the current job step and a template name, the utility THE uses the DD name.

ddname3 and *ddname4* are DD names.

You cannot have duplicate image copy data sets.

If you use the CONCURRENT and FILTERDDN options, ensure that the size of the copy data set is large enough to include all of the objects in the list.

FULL
Specifies that COPY is to make either a full or an incremental image copy.

YES
Specifies a full image copy. Making a full image copy resets the COPY-pending status for the table space or index, or for the partition if you specify DSNUM.

NO Specifies only an incremental image copy. Only changes since the last image copy are to be copied. **NO** is not valid for indexes.

Incremental image copies are not allowed in the following situations:

- The last full image copy of the table space was taken with the CONCURRENT option.
- No full image copies exist for the table space or data set that is being copied.
- After a successful LOAD or REORG operation, unless an inline copy was made during the LOAD or REORG job.
- You specify one of the following table spaces: DSNDB01.DBD01, DSNDB01.SYSUTILX, DSNDB06.SYSTSCPY, or DSNDB01.SYSDBDXA.
- A previous COPY was terminated with the -TERM UTIL command, so the most recent SYSIBM.SYSCOPY record for the object contains ICTYPE = T.
- If you specify both FLASHCOPY YES or CONSISTENT and FULL NO, the COPY utility issues an informational message and creates a FlashCopy image copy. (FlashCopy image copies are created as data set level copies of the object and cannot be incremental.) If you also request that sequential image copies be taken, those copies are created from the FlashCopy image copy.

For incremental image copies of partitioned table spaces, COPY includes the header page for each partition that has changed pages.

COPY automatically takes a full image copy of a table space if you specify FULL NO when an incremental image copy is not allowed.

Related information:

"Allocation of sequential image copy data sets" on page 175

CHANGELIMIT

The CHANGELIMIT option is deprecated, and the alternative is running DSNACCOX.Specifies the limit of changed pages in the table space, partition, or data set at which an incremental or full image copy is to be taken.

ANY
Specifies that COPY is to take a full image copy if any pages have changed since the last image copy.

percent_value1
Specifies the first value in the CHANGELIMIT range. *percent_value1* must be an integer or decimal value from 0.0 to 100.0. You do not need to specify leading zeroes, and the decimal point is not required when specifying a whole integer. Specify a maximum of one decimal place for a decimal value. For example, you can specify `.5`. If you specify this value, COPY takes an incremental image copy if more than one half of one percent of the pages have changed.

percent_value2
Specifies the second value in the CHANGELIMIT range. *percent_value2* must be an integer or decimal value from 0.0 to 100.0. You do not need to specify leading zeroes, and the decimal point is not required when specifying a whole integer. Specify a maximum of one decimal place for a decimal value (for example, `.5`).

COPY CHANGELIMIT accepts percentage values in any order. For example, you can specify (10,1) or (1,10).

If only one percentage value is specified, COPY CHANGELIMIT:

- Creates an incremental image copy if the percentage of changed pages is greater than 0 and less than *percent_value1*.
- Creates a full image copy if the percentage of changed pages is greater than or equal to *percent_value1*, or if CHANGELIMIT(0) is specified.
- Does not create an image copy if no pages have changed, unless CHANGELIMIT(0) is specified.
- Always creates a full image copy, even when no pages have been updated since the last image copy, if CHANGELIMIT(0) is specified.
- Creates a full image copy if CHANGELIMIT(100) is specified and all pages have been changed since the last image copy.
- Creates an incremental image copy if CHANGELIMIT(100) is specified and some but not all pages have been changed since the last image copy.

If two percentage values are specified, COPY CHANGELIMIT:

- Creates an incremental image copy if the percentage of changed pages is greater than the lowest specified value and less than the highest specified value.
- Creates a full image copy if the percentage of changed pages is equal to or greater than the highest specified value.
- Does not create an image copy if the percentage of changed pages is less than or equal to the lowest specified value.
- If both values are equal, creates a full image copy if the percentage of changed pages is equal to or greater than the specified value.

The default value is **(10)**.

You cannot use the CHANGELIMIT option for a table space or partition that is defined with TRACKMOD NO. If you change the TRACKMOD option from NO to YES, you must take an image copy before you can use the

CHANGELIMIT option. For nonpartitioned table spaces, you must copy the entire table space to allow future CHANGELIMIT requests.

Related information:

"Allocation of sequential image copy data sets" on page 175

REPORTONLY
Specifies that image copy information is to be displayed. If you specify the REPORTONLY option, only image copy information is displayed. Image copies are not taken in this case; they are only recommended.

DSNUM
For a table space, identifies a partition or data set within the table space to be copied; or it copies the entire table space. For an index space, DSNUM identifies a partition to be copied, or it copies the entire index space. This option can specify a partition of a data-partitioned secondary index if the index is copy-enabled.

If a data set of a nonpartitioned table space is in the COPY-pending status, you must copy the entire table space.

If DSNUM ALL is implicitly or explicitly specified for a table space that has a partition in PRO restricted status, COPY fails. If COPY is specified for a single partition that is in PRO restricted status, an informational message is issued, and no image copy is produced.

ALL
Indicates that the entire table space or index space is to be copied. You must use ALL for a nonpartitioned secondary index.

integer
Is the number of a partition or data set that is to be copied.

An integer value is not valid for nonpartitioned secondary indexes.

For a partitioned table space or index space, the integer is its physical partition number. The maximum is 4096.

For a nonpartitioned table space, find the integer at the end of the data set name as it is cataloged in the ICF catalog. The data set name has the following format:

catname.DSNDB*x*.*dbname*.*spacename*.*y*000*Z*.A*nnn*

In this format:

catname
Is the ICF catalog name or alias.

x Is C (for VSAM clusters) or D (for VSAM data components).

dbname
Is the database name.

spacename
Is the table space or index space name.

y Is I or J, which indicates the data set name used by REORG with FASTSWITCH.

z Is 1 or 2.

nnn Is the data set integer.

If COPY takes an image copy of data sets (rather than on table spaces), RECOVER, MERGECOPY, or COPYTOCOPY must use the copies on a data set level. For a nonpartitioned table space, if COPY takes image copies on data sets and you run MODIFY RECOVERY with DSNUM ALL, the table space is placed in COPY-pending status if a full image copy of the entire table space does not exist.

PARALLEL

For sequential format image copies, specifies the maximum number of objects in the list that are to be processed in parallel. The utility processes the list of objects in parallel for image copies being written to or from different disk or tape devices. If you specify TAPEUNITS with PARALLEL, you control the number of tape drives that are dynamically allocated for the copy.

If you omit PARALLEL, one object is copied at a time.

Restriction: Do not specify the PARALLEL keyword if one or more of the output data sets are defined with DD statements that specify UNIT=AFF to refer to the same device as a previous DD statement. This usage is not supported with the PARALLEL keyword and could result in an abend. Instead, consider using templates to define your data sets.

The PARALLEL keyword is ignored for FlashCopy image copies.

(*num-objects***)**

Specifies the number of objects in the list that are to be processed in parallel. You can adjust this value to a smaller value if COPY encounters storage constraints.

If you specify 0 or do not specify a value for *num-objects*, COPY determines the optimal number of objects to process in parallel.

TAPEUNITS

Specifies the maximum number of tape drives that the utility dynamically allocates for the list of objects to be processed in parallel. TAPEUNITS applies only to tape drives that are dynamically allocated through the TEMPLATE keyword. It does not apply to JCL allocated tape drives. The total number of tape drives allocated for the COPY request is the sum of the JCL allocated tape drives plus the number of tape drives determined as follows:

- the value that is specified for TAPEUNITS
- The value determined by the COPY utility if you omit the TAPEUNITS keyword

If you omit this keyword, the utility determines the number of tape drives to dynamically allocate for the copy function.

The TAPEUNITS keyword is ignored for FlashCopy image copies.

(*num-tape-units***)**

Specifies the number of tape drives to allocate. If you specify 0 or do not specify the TAPEUNITS keyword, COPY determines the maximum number of tape drives to be dynamically allocated for the function. COPY TAPEUNITS has a max value of 32767.

CHECKPAGE

Indicates that each page in the table space or index space is to be checked for validity. The validity checking operates on one page at a time and does not include any cross-page checking. If it finds an error, COPY issues a message that describes the type of error. If more than one error exists in a given page, only the first error is identified. COPY continues checking the remaining pages

in the table space or index space after it finds an error. CHECKPAGE is the default for table spaces. CHECKPAGE is not the default for indexes. This keyword is ignored by FlashCopy.

Note: Use of the CHECKPAGE option for indexes can result in greatly increased processor usage.

SYSTEMPAGES
Specifies whether the COPY utility puts system pages at the beginning of the image copy data set.

Although the system pages are located at the beginning of many image copies, this placement is not guaranteed. In many cases, the system pages are not included. For example, incremental copies do not include system pages. This keyword is ignored by FlashCopy.

YES
Ensures that any header, dictionary, and version system pages are copied at the beginning of the image copy data set. The version system pages can be copied twice.

Selecting YES ensures that the image copy contains the necessary system pages for subsequent UNLOAD utility jobs to correctly format and unload all data rows.

NO Does not ensure that the dictionary and version system pages are copied at the beginning of the image copy data set. The COPY utility copies the pages in the current order, including the header pages.

FLASHCOPY
Specifies whether FlashCopy technology is used to create a copy of the object. Valid values are YES, NO, or CONSISTENT. When FlashCopy is used, a separate data set is created for each partition or piece of the object.

Specify YES or CONSISTENT only if the DB2 data sets are on FlashCopy Version 2 disk volumes.

The FlashCopy specifications on the utility control statement override any specifications for FlashCopy that are defined by using the DB2 subsystem parameters. If the FlashCopy subsystem parameters specify the use of FlashCopy as the default behavior of this utility, the FLASHCOPY option can be omitted from the utility control statement.

Important: If the input data set is less than one cylinder, FlashCopy technology might not be used for copying the objects regardless of the FLASHCOPY settings. The copy is performed by IDCAMS if FlashCopy is not used.

For more information, see “FlashCopy image copies” on page 163.

NO Specifies that no FlashCopy is made. NO is the default value for FLASHCOPY.

YES
Specifies that FlashCopy technology is used to copy the object.

Important: Under the following circumstances, the COPY utility might not use FlashCopy even though YES is specified:

- FlashCopy Version 2 disk volumes are not available
- The source tracks are already the target of a FlashCopy operation
- The target tracks are the source of a FlashCopy operation

- The maximum number of relationships for the copy is exceeded

In the event that FlashCopy is not used, the COPY utility uses traditional I/O methods to copy the object, which can result in longer than expected execution time.

CONSISTENT

Specifies that when SHRLEVEL CHANGE is also specified, FlashCopy technology is used to copy the object and that any uncommitted work included in the copy is backed out of the copy to make the copy consistent. If SHRLEVEL CHANGE is not specified, specifying FLASHCOPY CONSISTENT is the same as specifying FLASHCOPY YES.

Specifying FLASHCOPY CONSISTENT requires additional time and system resources during utility processing, because the COPY utility must read the logs and apply the changes to the image copy. Similarly, recovering from a consistent FlashCopy image copy also requires additional time and system resources to read the logs and reapply work that was previously backed out.

Restriction: CONSISTENT cannot be specified when copying objects that have been defined with the NOT LOGGED attribute. If CONSISTENT is specified for an object that is defined with the NOT LOGGED attribute, the COPY utility does not make a copy of the object and issues message DSNU076I with return code 8.

FCCOPYDDN

Specifies the template to be used to create the FlashCopy image copy data set names. If a value is not specified for FCCOPYDDN on the COPY control statement when FlashCopy is used, the value specified on the FCCOPYDDN subsystem parameter determines the template to be used.

(*template-name***)**

The data set names for the FlashCopy image copy are allocated according to the template specification. For table space or index space level FlashCopy image copies, because a data set is allocated for each partition or piece, ensure that the data set naming convention in the template specification is unique enough. Use the &DSNUM variable, which resolves to a partition number or piece number at execution time.

CONCURRENT

Specifies that DFSMSdss concurrent copy is to make the full image copy. The image copy is recorded in the SYSIBM.SYSCOPY catalog table with ICTYPE=F and STYPE=C or STYPE=J.

If the SYSPRINT DD statement points to a data set, you must use a DSSPRINT DD statement.

When you specify SHRLEVEL(REFERENCE), an ICTYPE=Q record is placed into the SYSIBM.SYSCOPY catalog table after the object has been quiesced. If COPY fails, this record remains in SYSIBM.SYSCOPY. When COPY is successful, this ICTYPE=Q record is replaced with the ICTYPE=F record.

If the page size in the table space matches the control interval for the associated data set, you can use either the SHRLEVEL CHANGE option or the SHRLEVEL REFERENCE option with the CONCURRENT option. If the page size does not match the control interval, you must use the SHRLEVEL REFERENCE option for table spaces with a 8-KB, 16-KB, or 32-KB page size.

When you do not specify FILTERDDN, the DFSMSdss dump statement cannot include more than 255 data sets. When you request a concurrent copy on an object that exceeds this limitation, DB2 dynamically allocates a temporary filter data set for you.

FILTERDDN*ddname*
Specifies the optional DD statement for the filter data set that COPY is to use with the CONCURRENT option. COPY uses this data set to automatically build a list of table spaces that are to be copied by DFSMSdss with one DFSMSdss DUMP statement.

You can use the **FILTERDDN** keyword to specify either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

If you specify FILTERDDN, the SYSCOPY records for all objects in the list have the same data set name.

ddname is the DD name.

SHRLEVEL
Indicates whether other programs can access or update the table space or index while COPY is running.

REFERENCE
Allows read-only access by other programs.

CHANGE
Allows other programs to change the table space or index space.

When you specify SHRLEVEL CHANGE, uncommitted data might be copied.

When SHRLEVEL CHANGE with FLASHCOPY CONSISTENT is specified, the COPY utility uses DB2 shadow processing to backout uncommitted work to make the FlashCopy image copy consistent without any availability outage to applications. Application updates are allowed throughout the creation of the FlashCopy image copy and the creation of the sequential image copies.

Recommendation: Except when creating FlashCopy image copies or traditional image copies with SHRLEVEL CHANGE and FLASHCOPY CONSISTENT specified, do not use image copies that are made with SHRLEVEL CHANGE when you run RECOVER TOCOPY.

SHRLEVEL CHANGE is not allowed for a table space that is defined as NOT LOGGED unless it is a LOB table space and its base table space has the LOGGED attribute.

SHRLEVEL CHANGE is not allowed when you use DFSMSdss concurrent copy for table spaces that have a page size that is greater than 4 KB and does not match the control interval size. If the page size in the table space matches the control interval size for the associated data set, you can use either the SHRLEVEL CHANGE option or the SHRLEVEL REFERENCE option.

If you are copying a list and you specify the SHRLEVEL CHANGE option, you can specify OPTIONS EVENT(ITEMERROR,SKIP) so that each object in the list is placed in UTRW status and the read claim class is held only while the object is being copied.

The read claim class is briefly obtained for each object during the UTILINIT phase to determine the object size if LIMIT is specified on the COPYDDN or RECOVERYDDN template. This applies only if OPTIONS EVENT(ITEMERROR,SKIP) is specified.

If you do not specify OPTIONS EVENT(ITEMERROR,SKIP), all of the objects in the list are placed in UTRW status and the read claim class is held on all objects for the entire duration of the COPY.

SCOPE
Indicates the scope of the copy for the specified objects.

ALL
Indicates that you want to copy all of the specified objects.

PENDING

Indicates that you want to copy only those objects in COPY-pending or informational COPY-pending status. When the DSNUM ALL option is specified for partitioned objects, and one or more of the partitions are in COPY-pending or informational COPY-pending status, a copy will be taken of the entire table space or index space.

For partitioned objects, if you only want the partitions in COPY-pending status or informational COPY-pending status to be copied, then a list of partitions should be specified. This is done by invoking COPY on a LISTDEF list built with the PARTLEVEL option. An output image copy data set will be created for each partition that is in COPY-pending or informational COPY-pending status.

Related reference:

Chapter 19, "LISTDEF," on page 221

Chapter 35, "TEMPLATE," on page 789

Before running COPY

Certain activities might be required before you run the COPY utility, depending on your situation.

Before running COPY, check that the table spaces and index spaces that you want to copy are not in any restricted states.

Data sets that COPY uses

The COPY utility uses a number of data sets during its operation.

The following table lists the data sets that COPY uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 22. Data sets that COPY uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
DSSPRINT	Output data set for messages when making concurrent copies.	No[1]

Table 22. Data sets that COPY uses (continued)

Data set	Description	Required?
Filter	A single data set that DB2 uses when you specify the FILTERDDN option in the utility control statement. This data set contains a list of VSAM data set names that DB2 builds, and is used during COPY when you specify the CONCURRENT and FILTERDDN options.	No[2]
Sequential image copies	From one to four sequential output data sets that contain the resulting sequential format image copy data sets. Specify their DD names with the COPYDDN and RECOVERYDDN options of the utility control statement. The default is one copy to be written to the data set described by the SYSCOPY DD statement.	Yes
FlashCopy image copies	For table space or index space level copies, a VSAM data set for the output FlashCopy image copy of each partition or piece. For a partition level or piece level copy, a VSAM data set for the output FlashCopy image copy of the partition or piece.	No[3]

Note:

1. Required if you specify CONCURRENT and the SYSPRINT DD statement points to a data set.
2. Required if you specify the FILTERDDN option.
3. Required if you specify either FLASHCOPY YES or FLASHCOPY CONSISTENT.

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space or index space
Object that is to be copied. (If you want to copy only certain data sets in a table space, you must use the DSNUM option in the control statement.)

DB2 catalog objects
Objects in the catalog that COPY accesses. The utility records each copy in the DB2 catalog table SYSIBM.SYSCOPY.

Output data set size

Sequential image copies are written to sequential non-VSAM data sets.

FlashCopy image copies are written to VSAM data sets.

Recommendation: Use a template for the image copy data set by specifying a TEMPLATE statement without the SPACE keyword. When you omit this keyword, the utility calculates the appropriate size of the data set for you.

Alternatively, you can find the approximate size of the image copy data set for a table space, in bytes, by either executing COPY with the CHANGELIMIT REPORTONLY option, or using the following procedure:

1. Find the high-allocated page number, either from the NACTIVEF column of SYSIBM.SYSTABLESPACE after running the RUNSTATS utility, or from information in the VSAM catalog data set.
2. Multiply the high-allocated page number by the page size.

Filter data set size

Recommendation: Use a template for the filter data set by specifying a TEMPLATE statement without the SPACE keyword. When you omit this keyword, the utility calculates the appropriate size of the data set for you.

Alternatively, you can determine the approximate size of the filter data set size that is required, in bytes, by using the following formula, where *n* = the number of specified objects in the COPY control statement:

```
(240 + (80 * n))
```

JCL parameters

For the output data sets of sequential format image copies, you can specify a block size by using the BLKSIZE parameter on the DD statement for the output data set. Valid block sizes are multiples of 4096 bytes. You can increase the buffer using the BUFNO parameter; for example, you might specify BUFNO=30, which creates 30 buffers.

For the output data sets of image copies created by invoking either the concurrent copy function or FlashCopy function of DFSMSdss, the required specifications for the output data sets might be different than those for sequential format image copies. For example, the BUFNO parameter does not apply to the output data sets for concurrent image copies.

Cataloging image copies

To catalog your image copy data sets, use the DISP=(MOD,CATLG,CATLG) parameter in the DD statement or TEMPLATE that is named by the COPYDDN option. After the image copy is taken, the DSVOLSER column of the row that is inserted into SYSIBM.SYSCOPY contains blanks.

FlashCopy image copy data sets are always cataloged. The DISP= parameter is not specified in the FlashCopy template. After the image copy is taken, unless uncommitted work is backed out of the image copy when FLASHCOPY CONSISTENT is specified, the DSVOLSER column of the row that is inserted into SYSIBM.SYSCOPY contains blanks. If uncommitted work is backed out of a FlashCopy image copy, the DSVOLSER column contains the DB2 checkpoint information for each member.

Duplicate image copy data sets are not allowed. If a cataloged data set is already recorded in SYSIBM.SYSCOPY with the same name as the new image copy data set, the COPY utility issues a message and does not make the copy.

When RECOVER locates the SYSCOPY entry, it uses the operating system catalog to allocate the required data set. If you have uncataloged the data set, the allocation fails. In that case, the recovery can still go forward; RECOVER searches for a previous image copy. But even if it finds one, RECOVER must use correspondingly more of the log during recovery.

Recommendation: Keep the ICF catalog consistent with the information about existing image copy data sets in the SYSIBM.SYSCOPY catalog table.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for COPY

The COPY utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Restricted states

Do not copy a table space that is in any of the following states:
- CHECK-pending
- RECOVER-pending
- REFRESH-pending
- Logical error range
- Group buffer pool RECOVER-pending
- Stopped
- STOP-pending
- PRO restricted status

Do not copy an index space that is in any of the following states:
- CHECK-pending
- REBUILD-pending
- RECOVER-pending
- REFRESH pending
- Logical error range
- Group buffer pool RECOVER-pending
- Stopped
- STOP-pending

If a table space is in COPY-pending status, or a table space or index is in informational COPY-pending status, you can reset the status only by taking a full image copy of the entire table space, all partitions of the partitioned table space, or the index space. When you make an image copy of a partition, the COPY-pending status of the partition is reset. If a nonpartitioned table space is in COPY-pending status, you can reset the status only by taking a full image copy of the entire table space, and not of each data set.

Claims and drains

The following table shows which claim classes COPY claims and drains and any restrictive status that the utility sets on the target object.

Table 23. Claim classes of COPY operations

Target	SHRLEVEL REFERENCE	SHRLEVEL CHANGE
Table space, index space, or partition	DW UTRO	CR UTRW[1]

Table 23. Claim classes of COPY operations (continued)

Target	SHRLEVEL REFERENCE	SHRLEVEL CHANGE

Legend:
- DW - Drain the write claim class - concurrent access for SQL readers
- CR - Claim the read claim class
- UTRO - Utility restrictive state, read-only access allowed
- UTRW - Utility restrictive state, read-write access allowed

Note:

1. If the target object is a segmented table space, SHRLEVEL CHANGE does not allow you to concurrently execute an SQL DELETE without the WHERE clause.

COPY does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

Compatibility

The following table documents which utilities can run concurrently with COPY on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also documented in the table.

Table 24. Compatibility of COPY with other utilities

Action	COPY INDEXSPACE SHRLEVEL REFERENCE	COPY INDEXSPACE SHRLEVEL CHANGE	COPY TABLESPACE SHRLEVEL REFERENCE[1]	COPY TABLESPACE SHRLEVEL CHANGE
BACKUP SYSTEM	Yes	Yes	Yes	Yes
CHECK DATA	Yes	Yes	No	No
CHECK INDEX	Yes	Yes	Yes	Yes
CHECK LOB	Yes	Yes	Yes	Yes
COPY INDEXSPACE	No	No	Yes	Yes
COPY TABLESPACE	Yes	Yes	No	No
COPYTOCOPY	No	No	No	No
DIAGNOSE	Yes	Yes	Yes	Yes
LOAD	No	No	No	No
MERGECOPY	No	No	No	No
MODIFY	No	No	No	No
QUIESCE	Yes	No	Yes	No
REBUILD INDEX	No	No	Yes	Yes
RECOVER INDEX	No	No	Yes	Yes
RECOVER TABLESPACE	Yes	Yes	No	No
REORG INDEX	No	No	Yes	Yes
REORG TABLESPACE SHRLEVEL CHANGE	No	No	No	Yes[2]
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No	No	No

Table 24. Compatibility of COPY with other utilities (continued)

Action	COPY INDEXSPACE SHRLEVEL REFERENCE	COPY INDEXSPACE SHRLEVEL CHANGE	COPY TABLESPACE SHRLEVEL REFERENCE[1]	COPY TABLESPACE SHRLEVEL CHANGE
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes	Yes	Yes	Yes
REPAIR LOCATE by KEY, RID, or PAGE DUMP or VERIFY	Yes	Yes	Yes	Yes
REPAIR LOCATE by KEY or RID DELETE or REPLACE	No	No	No	No
REPAIR LOCATE INDEX PAGE REPLACE	No	No	Yes	No
REPAIR LOCATE TABLESPACE PAGE REPLACE	Yes	Yes	No	No
REPORT	Yes	Yes	Yes	Yes
RESTORE SYSTEM	No	No	No	No
RUNSTATS INDEX	Yes	Yes	Yes	Yes
RUNSTATS TABLESPACE	Yes	Yes	Yes	Yes
STOSPACE	Yes	Yes	Yes	Yes
UNLOAD[1]	Yes	Yes	Yes	Yes

Note:

1. If CONCURRENT option is used, contention might be encountered when other utilities are run on the same object at the same time.
2. REORG TABLESPACE SHRLEVEL CHANGE and COPY SHRLEVEL CHANGE are compatible and can run concurrently except during the period when exclusive control is needed to drain claimers of a target table space.
   Restriction:
   - COPY with the FLASHCOPY CONSISTENT option is not compatible with REORG.
   - If REORG has drained the claimers of a table space or table space partition and a COPY utility is submitted to access the same object, the COPY utility terminates with a message that it is not compatible.
   - If COPY and REORG are accessing the same table space or table space partitions, REORG cannot drain claimers until COPY completes. The REORG DRAIN options determine the actions taken.
   - If COPY and REORG are accessing the same table space or table space partitions and COPY abends, restart of the COPY is not allowed if REORG completes.

To run on DSNDB01.SYSUTILX, COPY must be the only utility in the job step. Also, if SHRLEVEL REFERENCE is specified, the COPY job of DSNDB01.SYSUTILX must be the only utility running in the Sysplex.

COPY on SYSUTILX is an "exclusive" job; such a job can interrupt another job between job steps, possibly causing the interrupted job to time out.

Related tasks:

"Monitoring utilities" on page 47

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Full image copies

You can make full image copies of a variety of data objects. Data objects include table spaces, table space partitions, data sets of nonpartitioned table spaces, index spaces, and index space partitions.

The following statement specifies that the COPY utility is to make a full image copy of the DSN8S11E table space in database DSN8D11A:

```
COPY TABLESPACE DSN8D11A.DSN8S11E
```

The COPY utility writes pages from the table space or index space to the output data sets. The JCL for the utility job must include DD statements or have a template specification for the data sets. If the object consists of multiple data sets and all are copied in one run, the copies reside in one physical sequential output data set.

For sequential image copies, if the object consists of multiple data sets and all are copied in one run, the copies reside in one physical sequential output data set. For FlashCopy image copies, if the object consists of multiple data sets and all are copied in one run, there is a FlashCopy image copy data set for each data set.

Image copies should be made either by entire page set or by partition, but not by both.

Recommendations:

- Take a full image copy after any of the following operations:
  - CREATE or LOAD operations for a new object that is populated.
  - REORG operation for an existing object.
  - LOAD RESUME of an existing object.
  - LOGGED operation of a table space.
- Copy the indexes over a table space whenever a full copy of the table space is taken. More frequent index copies decrease the number of log records that need to be applied during recovery. At a minimum, you should copy an index when it is placed in informational COPY-pending (ICOPY) status.

If you create an inline copy during LOAD or REORG, you do not need to execute a separate COPY job for the table space. If you do not create an inline copy, and if the LOG option is NO, the COPY-pending status is set for the table space. You must then make a full image copy for any subsequent recovery of the data. An incremental image copy is not allowed in this case. If the LOG option is YES, the COPY-pending status is not set. However, your next image copy must be a full image copy. Again, an incremental image copy is not allowed.

The COPY utility automatically takes a full image copy of a table space if you attempt to take an incremental image copy when it is not allowed.

If a table space changes after an image copy is taken and before the table space is altered from NOT LOGGED to LOGGED, the table space is marked COPY-pending, and a full image copy must be taken.

The catalog table SYSIBM.SYSCOPY and the directory tables SYSIBM.SYSUTILX and SYSIBM.SYSLGRNX record information from the COPY utility. Copying the

table spaces for those tables can lock out separate COPY jobs that are running simultaneously; therefore, defer copying the table spaces for SYSIBM.SYSCOPY, SYSIBM.SYSUTILX, and SYSIBM.SYSLGRNX until the other copy jobs have completed. However, if you must copy other objects while another COPY job processes the catalog or directory, specify SHRLEVEL(CHANGE) for copying the catalog and directory table spaces. Beginning in DB2 Version 10, the COPY control statements in the DSNTIJIC job specify SHRLEVEL(CHANGE).

Related concepts:

"Copying catalog and directory objects" on page 170

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

Incremental image copies

An incremental image copy is a copy of the pages that have been changed since the last full or incremental image copy.

You cannot take an incremental image copy of an index space.

You can make an incremental image copy of a table space if the following conditions are true:

- A full image copy of the table space exists.
- The COPY-pending status is not on for that table space.
- The last copy was taken without the CONCURRENT option.
- The previous copy was not made by using FlashCopy. This applies even if sequential copies were made from the FlashCopy image copy.

Copy by partition or data set

You can make an incremental image copy by partition or data set (specified by DSNUM) in the following situations:

- A full image copy of the table space exists.
- A full image copy of the same partition or data set exists and the COPY-pending status is not on for the table space or partition.

In addition, the full image copy must have been made after the most recent use of CREATE, REORG or LOAD, or it must be an inline copy that was made during the most recent use of LOAD or REORG.

Sample control statement

To specify an incremental image copy, use FULL NO on the COPY statement, as in the following example:

```
COPY TABLESPACE DSN8D11A.DSN8S11E  FULL NO   SHRLEVEL CHANGE
```

Performance advantage

An incremental image copy generally does not require a complete scan of the table space, with two exceptions:

- The table space is defined with the TRACKMOD NO option.
- You are taking the first copy after you altered a table space to TRACKMOD YES.

Space maps in each table space indicate, for each page, regardless of whether it has changed since the last image copy. Therefore, making an incremental copy can be

significantly faster than making a full copy if the table space is defined with the TRACKMOD YES option. Incremental image copies of a table space that is defined with TRACKMOD NO still saves space, although the performance advantage is smaller.

Restriction: You cannot make incremental copies of DSNDB01.DBD01, DSNDB01.SYSDBDXA, DSNDB01.SYSUTILX, or DSNDB06.SYSTSCPY in the catalog. For those objects, COPY always makes a full image copy and places the SYSCOPY record in the log.

Multiple image copies

In a single COPY job, you can create up to five exact copies of various data objects. Data objects include table spaces, table space partitions, data sets of a nonpartitioned table space, index spaces, and index space partitions.

You can make two sequential copies for use on the local DB2 system (installed with the option LOCALSITE), and two more for offsite recovery (on any system that is installed with the option RECOVERYSITE). You can also make a fifth FlashCopy image copy for use on the local DB2 system. All copies are identical, and all are produced at the same time from one invocation of COPY.

Alternatively you can use COPYTOCOPY to create the needed image copies. COPYTOCOPY can be used to create sequential image copies from a FlashCopy image copy.

The ICBACKUP column in SYSIBM.SYSCOPY specifies whether the image copy data set is for the local or recovery system, and whether the image copy data set is for the primary copied data set or for the backup copied data set. The ICUNIT column in SYSIBM.SYSCOPY specifies whether the image copy data set is on tape or disk.

Remote-site recovery

For remote site recovery, DB2 assumes that the system and application libraries and the DB2 catalog and directory are identical at the local site and recovery site. You can regularly transport copies of archive logs and database data sets to a safe location to keep current data for remote-site recovery current. This information can be kept on tape until needed.

Naming the data sets for the copies

The COPYDDN option of COPY names the output data sets that receive copies for local use. The RECOVERYDDN option names the output data sets that receive copies that are intended for remote-site recovery. The options have the following formats:

```
COPYDDN (ddname1,ddname2)   RECOVERYDDN (ddname3,ddname4)
```

The DD names for the primary output data sets are *ddname1* and *ddname3*. The ddnames for the backup output data sets are *ddname2* and *ddname4*.

Sample control statement

The following statement makes four full image copies of the table space DSN8S11E in database DSN8D11A. The statement uses LOCALDD1 and LOCALDD2 as DD

names for the primary and backup copies that are used on the local system and RECOVDD1 and RECOVDD2 as DD names for the primary and backup copies for remote-site recovery:

```
COPY TABLESPACE DSN8D11A.DSN8S11E
   COPYDDN (LOCALDD1,LOCALDD2)
   RECOVERYDDN (RECOVDD1,RECOVDD2)
```

You do not need to make copies for local use and for remote-site recovery at the same time. COPY allows you to use either the COPYDDN or the RECOVERYDDN option without the other. If you make copies for local use more often than copies for remote-site recovery, a remote-site recovery could be performed with an older copy, and more of the log, than a local recovery; hence, the recovery would take longer. However, in your plans for remote-site recovery, that difference might be acceptable. You can also use MERGECOPY RECOVERYDDN to create recovery-site full image copies, and merge local incremental copies into new recovery-site full copies.

Conditions for making multiple incremental image copies

DB2 cannot make incremental image copies if any of the following conditions is true:

- The incremental image copy is requested only for a site other than the current site (the local site from which the request is made).
- Incremental image copies are requested for both sites, but the most recent full image copy was made for only one site.
- Incremental image copies are requested for both sites and the most recent full image copies were made for both sites, but between the most recent full image copy and current request, incremental image copies were made for the current site only.

If you attempt to make incremental image copies under any of these conditions, COPY terminates with return code 8, does not take the image copy or update the SYSIBM.SYSCOPY table, and issues the following message:

```
DSNU404I  csect-name
  LOCAL SITE AND RECOVERY SITE INCREMENTAL
           IMAGE COPIES ARE NOT SYNCHRONIZED
```

To proceed, and still keep the two sets of data synchronized, take another full image copy of the table space for both sites, or change your request to make an incremental image copy only for the site at which you are working.

DB2 cannot make an incremental image copy if the object that is being copied is an index or index space.

Maintaining copy consistency

Make full image copies for both the local and recovery sites:

- If a table space is in COPY-pending status
- After a LOAD or REORG procedure that did not create an inline copy
- If an index is in the informational COPY-pending status
- If a table space is in informational COPY-pending status

This action helps to ensure correct recovery for both local and recovery sites. If the requested full image copy is for one site only, but the history shows that copies were made previously for both sites, COPY continues to process the image copy and issues the following warning message:

```
DSNU406I  FULL IMAGE COPY SHOULD BE TAKEN FOR BOTH LOCAL SITE AND
           RECOVERY SITE.
```

The COPY-pending status of a table space is not changed for the other site when you make multiple image copies at the current site for that other site. For example, if a table space is in COPY-pending status at the current site, and you make copies from there for the other site only, the COPY-pending status is still on when you bring up the system at that other site.

Related reference:

Chapter 16, "COPYTOCOPY," on page 191

FlashCopy image copies

You can configure certain utilities to create image copies by using the FlashCopy function that is provided by z/OS DFSMS and the IBM TotalStorage ESS storage subsystems. FlashCopy can reduce both the unavailability of data during the copy operation and the amount of time that is required for backup and recovery operations.

The FlashCopy image copy is allocated by DFSMSdss and is always cataloged.

FlashCopy image copies are output to VSAM data sets. The traditional copy methods that are used by the utilities output to a non-VSAM sequential format data set. FlashCopy creates a separate VSAM data set for each partition or piece of the object that is being copied.

When creating a FlashCopy image copy, the following utilities also can create one to four additional sequential format image copies in a single execution:

- COPY
- LOAD with the REPLACE option specified
- REORG TABLESPACE

The COPYTOCOPY utility can create sequential format image copies by using an existing FlashCopy image copy as input.

Recommendation: To provide a recovery base for media failures, create one or more additional sequential format image copies when you create a FlashCopy image copy.

Operational restrictions for FlashCopy

A data-set-level FlashCopy has certain operational restrictions that can cause a utility to resort to traditional I/O methods to complete a copy operation. This behavior can occur even when you explicitly request FlashCopy support in either the subsystem parameter or the utility control statement. In some cases, the utility aborts the copy operation.

The circumstances in which the utilities might not be able to complete a copy operation by using FlashCopy include the following situations. In these situations, the term *data set* refers to a DB2 table space or index space or a FlashCopy image copy:

- FlashCopy Version 2 disk volumes are not available.
- The source data set is already the target of a FlashCopy relationship.
- The target data set is already the source of a FlashCopy relationship.

- The source data set is already participating in the maximum number of FlashCopy relationships.
- The CISIZE, CASIZE, physical record size, or physical block size of the target data set is different from that of the source data set. The CASIZE of the target data set can be different from the source data set if the source data set is less than one cylinder.
- The source data set and the target data set are not both fully contained on the same physical control unit (controller).

  Recommendation: Use the storage class attribute ACCESSIBILITY=REQUIRED or ACCESSIBILITY=PREFERRED for the source data set and for the target data set. If the storage class that is associated with a data set has this attribute, DFSMS attempts to select volumes such that the data set is contained on volumes within a single physical control unit.
- Either the source data set or the target data set is not SMS-managed.

For more information about FlashCopy restrictions, see Moving Data Sets with FlashCopy (z/OS DFSMSdss Storage Administration).

If FlashCopy cannot be used, the utility completes the copy operation by using traditional I/O methods to copy the object, which can result in longer than expected execution time.

Only one utility can create a FlashCopy image copy of an object at one time. For example, suppose that the COPY utility with the SHRLEVEL CHANGE and FLASHCOPY options is running on an object. Then, the LOAD utility with the SHRLEVEL CHANGE and FLASHCOPY options starts running on the same object. The LOAD utility receives message DSNU180I with a return code of 8 to indicate that the LOAD utility is not compatible with the COPY utility.

Specification of the FlashCopy option

For utilities that support the creation of FlashCopy image copies, you can specify the FlashCopy option by using DB2 subsystem parameters, utility control statement parameters, or both.

You can use the FlashCopy subsystem parameters to define the FlashCopy option as the default behavior for each of the utilities that support the FlashCopy option. When the FlashCopy subsystem parameters are enabled as the default behavior, you do not need to specify the FlashCopy options in the utility control statement.

If you specify the FlashCopy options in both the subsystem parameters and the utility control statement parameters, the specifications in the utility control statement override the specifications of the subsystem parameters.

Image copy consistency with FlashCopy

The support for FlashCopy provided by the COPY and LOAD utilities includes an option that can make an image copy consistent for recovery purposes.

When you specify the SHRLEVEL CHANGE and FLASHCOPY CONSISTENT options, the utility does some extra checking after the FlashCopy image copy is created. The utility checks the logs for changes to the copied data that were

uncommitted at the time that the image copy was created. Any uncommitted data that is identified in the logs is backed out of the image copy before the utility terminates.

DB2 shadow processing is used to make the FlashCopy image copy consistent. The FlashCopy image copy data set is used as the shadow. Other utilities that use DB2 shadow processing use a different naming convention.

The process of creating an image copy by specifying FLASHCOPY CONSISTENT uses more system resources and takes longer than creating an image copy by specifying FLASHCOPY YES. The reason is that backing out uncommitted work requires reading the logs and updating the image copy.

Restriction: You cannot specify CONSISTENT when copying objects that are defined with the NOT LOGGED attribute.

SYSCOPY records for FlashCopy image copies

For each FlashCopy image copy, DB2 creates one or more records in the SYSIBM.SYSCOPY table. SYSCOPY records for FlashCopy image copies can differ slightly from the SYSCOPY records for sequential format image copies depending on the following factors:

- Whether the object that is being copied is partitioned
- The number of partitions or object pieces that are being copied

For a FlashCopy image copy of a single partition or piece of an object, one SYSCOPY record is created for the partition or piece.

For a FlashCopy image copy of a table space or index space:

- If a table space contains more than one partition or piece, DB2 creates a separate SYSCOPY record for each of the following items:
  - The table space or index space
  - Each partition or piece in the table space or index space

  In the DSNUM column of the SYSCOPY record, DB2 assigns a data set number to the table space or index space and to each partition or piece. The data set numbers start at 0 for the table space or index space and are incremented by 1 for each partition or piece.

  For example, if a table space has two partitions, a FlashCopy image copy of the table space creates three SYSCOPY records:

  1. A SYSCOPY record for the tables space with DSNUM=0
  2. A SYSCOPY record for the first partition with DSNUM=1
  3. A SYSCOPY record for the second partition with DSNUM=2
- If there is only one partition or piece in the table space, only one SYSCOPY record is created with DSNUM=0.

For FlashCopy image copies that were created with the FLASHCOPY YES option, the START_RBA value corresponds to the RBA or LRSN when the object's pages were last externalized to disk.

For FlashCopy image copies that were created with the FLASHCOPY CONSISTENT option and have undergone consistency processing, the START_RBA value corresponds to one of the following values, depending on whether active units of work existed:

- If active units of work existed, the START_RBA value corresponds to the beginning RBA or LRSN of the oldest uncommitted unit of work that was backed out.
- If no active units of work existed, the START_RBA value corresponds to the RBA or LRSN when the object's pages were last externalized to disk.

In the SYSCOPY section of the output from REPORT RECOVERY, the SYSCOPY records are presented in ascending START_RBA order and not in timestamp order. Thus, the SYSCOPY records for FlashCopy image copies might be shown in the REPORT RECOVERY out of chronological order as compared to other SYSCOPY records.

The implication of the START_RBA value for FlashCopy image copies is that a recovery from a FlashCopy image copy likely requires more log processing.

Recovery and FlashCopy image copies

Using FlashCopy to create image copies has the several implications for recovery. Those implications are described in "Recovering with FlashCopy image copies" on page 480

Utility support for FlashCopy

The following DB2 for z/OS utilities can use FlashCopy to create image copies:

- COPY
- LOAD
- REBUILD INDEX
- REORG INDEX
- REORG TABLESPACE

When creating a FlashCopy image copy, the COPY and LOAD utilities with SHRLEVEL CHANGE can include additional phases of execution, depending on the options that are specified in the utility control statement. The additional execution phases include:

LOGAPPLY
: If CONSISTENT was specified for either the COPY utility or the LOAD utility, the utility identifies the most recent checkpoint for each member. All objects that are being copied are updated to the same log point to prepare for backout processing.

LOGCSR
: If CONSISTENT was specified for either the COPY utility or the LOAD utility, the utility reads the logs during this phase. The utility uses the logs to identify the uncommitted work that needs to be backed out of the image copy.

LOGUNDO
: If CONSISTENT was specified for either the COPY utility or the LOAD utility, the utility backs out uncommitted work to make the image copy consistent.

SEQCOPY
: If additional sequential format image copies are requested, the COPY utility creates them from the FlashCopy image copy during this phase.

The following utilities accept the VSAM data sets that are produced by FlashCopy as input:

- COPYTOCOPY
- DSN1COMP
- DSN1COPY
- DSN1PRNT
- RECOVER

The UNLOAD utility does not accept FlashCopy image copies as input. To use a FlashCopy image copy as the source for the UNLOAD utility, use the COPYTOCOPY utility to create sequential format image copies from the FlashCopy image copy.

Related concepts:

"Subsystem parameters for refining DFSMSdss COPY operation with utilities" on page 48

Related reference:

"Syntax and options of the COPY control statement" on page 141

DB2 utilities parameters panel 1: DSNTIP6 (DB2 Installation and Migration)

"Syntax and options of the LOAD control statement" on page 247

"Syntax and options of the REBUILD INDEX control statement" on page 428

"Syntax and options of the REORG INDEX control statement" on page 514

"Syntax and options of the REORG TABLESPACE control statement" on page 555

Copies of lists of objects

Within a single COPY control statement, the COPY utility allows you to process a list that contains any of the following objects: table space, table space partition, data set of a nonpartitioned table space, index space, and index space partition.

Specifying objects in a list is useful for copying a complete set of referentially related table spaces before running QUIESCE. Consider the following information when taking an image copy for a list of objects:

- DB2 copies table spaces and index spaces in the list one at a time, in the specified order, unless you invoke parallelism by specifying the PARALLEL keyword.
- Each table space in the list with a CHANGELIMIT specification has a REPORT phase, so the phase switches between REPORT and COPY while processing the list.
- If processing completes successfully, any COPY-pending or informational COPY-pending status on the table spaces and informational COPY-pending status on the indexes are reset.
- If you use COPY with the SHRLEVEL(REFERENCE) option:
  - DB2 drains the write claim class on each table space and index in the UTILINIT phase, which is held for the duration of utility processing.
  - Utility processing inserts SYSCOPY rows for all of the objects in the list at the same time, after all of the objects have been copied.
  - All objects in the list have identical RBA or LRSN values for the START_RBA column for the SYSCOPY rows: the START_RBA is set to the current LRSN at the end of the COPY phase.
- If you use COPY with the SHRLEVEL(CHANGE) option:

- If you specify OPTIONS EVENT(ITEMERROR,SKIP), each object in the list is placed in UTRW status and the read claim class is held only while the object is being copied. If you do not specify OPTIONS EVENT(ITEMERROR,SKIP), all of the objects in the list are placed in UTRW status and the read claim class is held on all objects for the entire duration of the COPY.
- Utility processing inserts a SYSCOPY row for each object in the list when the copy of each object is complete.
- Objects in the list have different LRSN values for the START_RBA column for the SYSCOPY rows; the START_RBA value is set to the current RBA or LRSN at the start of copy processing for that object.

When you specify the PARALLEL keyword, DB2 supports parallelism for image copies on disk or tape devices. You can control the number of tape devices to allocate for the copy function by using TAPEUNITS with the PARALLEL keyword. If you use JCL statements to define tape devices, the JCL controls the allocation of the devices.

When you explicitly specify objects with the PARALLEL keyword, the objects are not necessarily processed in the specified order. Objects that are to be written to tape and whose file sequence numbers have been specified in the JCL are processed in the specified order. If templates are used, you cannot specify file sequence numbers. In the absence of overriding JCL specifications, DB2 determines the placement and, thus, the order of processing for such objects. When only templates are used, objects are processed according to their size, with the largest objects processed first.

Both the PARALLEL and TAPEUNITS keywords act as constraints on the processing of the COPY utility. The PARALLEL keyword constrains the amount of parallelism by restricting the maximum number of objects that can be processed simultaneously. The TAPEUNITS keyword constrains the number of tape drives that can be dynamically allocated for the COPY command. The TAPEUNITS keyword can constrain the amount of parallelism if an object requires a number of tapes such that the number of remaining tapes is insufficient to service another object.

To calculate the number of threads that you need when you specify the PARALLEL keyword, use the formula (n * 2 + 1), where n is the number of objects that are to be processed in parallel, regardless of the total number of objects in the list. If you do not use the PARALLEL keyword, n is 1 and COPY uses three threads for a single-object COPY job.

COPY SCOPE PENDING indicates that you want to copy only those objects in COPY-pending or informational COPY-pending status. When the DSNUM ALL option is specified for partitioned objects, and one or more of the partitions are in COPY-pending or informational COPY-pending status, a copy will be taken of the entire table space or index space.

For partitioned objects, if you only want the partitions in COPY-pending status or informational COPY-pending status to be copied, then a list of partitions should be specified. It is recommended that you do this by invoking COPY on a LISTDEF list built with the PARTLEVEL option. An output image copy data set will be created for each partition that is in COPY-pending or informational COPY-pending status.

The LIMIT option on the TEMPLATE statement allows you to switch templates for output copy data sets. Template switching is most commonly needed to direct

small data sets to DASD and large data sets to TAPE. This allows you to switch to templates that differ in the UNIT, DSNs, or HSM classes.

The following table spaces cannot be included in a list of table spaces. You must specify each one as a single object:
- DSNDB01.SYSUTILX
- DSNDB06.SYSTSCPY
- DSNDB01.SYSLGRNX
- DSNDB01.SYSDBDXA

The only exceptions to this restriction are the indexes over these table spaces that were defined with the COPY YES attribute. You can specify such indexes along with the appropriate table space.

Related reference:

Chapter 35, "TEMPLATE," on page 789

Using more than one COPY statement

You can use more than one control statement for COPY in one DB2 utility job step.

About this task

After each COPY statement executes successfully:
- A row that refers to each image copy is recorded in the SYSIBM.SYSCOPY table.
- The image copy data sets are valid and available for RECOVER, MERGECOPY, COPYTOCOPY, and UNLOAD.

If a job step that contains more than one COPY statement abends, **do not** use **TERM UTILITY**. Restart the job from the last commit point by using RESTART instead. Terminating COPY by using **TERM UTILITY** in this case creates inconsistencies between the ICF catalog and DB2 catalogs.

Copying partitions or data sets simultaneously

To potentially improve the performance of the COPY utility, copy partitions or data sets at the same time.

About this task

Procedure

To copy partitions or data sets simultaneously:
- If the table space is partitioned, take one of the following actions:
  - Specify the PARALLEL option in the COPY utility control statement to copy partitions in the same COPY execution in parallel.
  - Copy the partitions independently in separate simultaneous jobs. This method can reduce the time that it takes to create sequential image copies of the entire table space.
- If the table space is a nonpartitioned table space that consists of more than one data set, copy several or all of the data sets independently in separate jobs. To do so, run simultaneous COPY jobs (one job for each data set) and specify SHRLEVEL CHANGE on each job. However, creating copies simultaneously does not provide you with a consistent recovery point unless you subsequently run a QUIESCE for the table space.

Related reference:

"Syntax and options of the COPY control statement" on page 141

Copies of partition-by-growth table spaces

An image copy at the table space level with SHRLEVEL(CHANGE) will not contain any new partitions that are added by SQL INSERT operations after the image copy began. The newly added partitions can be recovered by using the DB2 logs.

When you make an image copy of a partition-by-growth table space, a partition might be empty as a result of REORG, SQL delete operations, or recovery to a prior point in time. The empty partition has a header page and space map pages or system pages. The COPY utility still copies the empty partition.

Copies of XML table spaces

The COPY utility supports full and incremental image copies for XML table spaces. The COPY utility options SHRLEVEL REFERENCE, SHRLEVEL CHANGE, CONCURRENT, and FLASHCOPY are also supported for XML table spaces.

Unless either the CONCURRENT option or the FLASHCOPY option is specified, COPY does not copy empty or unformatted data pages of an XML table space.

If you copy a LOB table space that has a base table space with the NOT LOGGED attribute, copy the base table space and the LOB table space together so that a RECOVER TOLOGPOINT of the entire set results in consistent data across the base table space and all of the associated LOB table spaces.

Note: RECOVER TOLASTCOPY is not allowed on a list of objects. Instead, use RECOVER TOLOGPOINT, where the TOLOGPOINT is the common RBA or LRSN associated with the SHRLEVEL REFERENCE image copies.

To copy an XML table space with a base table space that has the NOT LOGGED attribute, all associated XML table spaces must also have the NOT LOGGED attribute. The XML table space acquires this NOT LOGGED attribute by being linked to the logging attribute of its associated base table space. You cannot independently alter the logging attribute of an XML table space.

If the LOG column of the SYSIBM.SYSTABLESPACE record for an XML table space has the value of "X", the logging attributes of the XML table space and its base table space are linked, and that the logging attribute of both table spaces is NOT LOGGED. To break the link, alter the logging attribute of the base table space back to LOGGED, and the logging attribute of both table spaces are changed back to LOGGED.

Copying catalog and directory objects

Use the DSNTIJIC installation job to create backup copies of catalog and directory objects.

If you are migrating from a Version 9 or earlier DB2 for z/OS system, and your Version 10 or later DB2 for z/OS system is in conversion mode, use the DSNTIJIC job that is produced by running the installation CLIST in MIGRATE mode.

If you are migrating from a Version 9 or earlier DB2 for z/OS system, and your Version 10 or later DB2 for z/OS system is in conversion mode, use the DSNTIJIC job that is produced by running the installation CLIST in MIGRATE mode.

Depending on the migration mode in which the DB2 for z/OS system is running, the COPY utility skips new or obsolete catalog and directory objects during processing and issues message DSNU1530I with RC0 for each skipped object. For example, in conversion mode, the COPY utility skips catalog and directory objects that are new for the version to which you are migrating. In new function mode, the COPY utility skips catalog and directory objects that are obsolete in the version to which you are migrating.

If the output image copy has a hardcoded DD statement to a tape device, the COPY utility opens and closes the data set to write a tape mark. This ensures that subsequent image copies stacked to the same tape volume can be written.

Specifying OPTIONS EVENT(ITEMERROR,SKIP) or OPTIONS EVENT(ITEMERROR,HALT) does not impact the skipping of new or obsolete objects.

The catalog table SYSIBM.SYSCOPY and the directory tables SYSIBM.SYSUTILX and SYSIBM.SYSLGRNX record information from the COPY utility. Copying the table spaces for those tables can lock out separate COPY jobs that are running simultaneously; therefore, defer copying the table spaces for SYSIBM.SYSCOPY, SYSIBM.SYSUTILX, and SYSIBM.SYSLGRNX until the other copy jobs have completed. However, if you must copy other objects while another COPY job processes the catalog or directory, specify SHRLEVEL(CHANGE) for copying the catalog and directory table spaces. Beginning in DB2 Version 10, the COPY control statements in the DSNTIJIC job specify SHRLEVEL(CHANGE).

Related information:

DSNU1530I (DB2 Messages)

Make copies of XML schema repository objects

Although the XML schema repository is not part of the DB2 catalog, you need to create backup copies of XML schema repository table spaces when you back up catalog objects.

To determine which table spaces are part of the XML schema repository, see job DSNTESR.

The table spaces for which you need to make image copies are in database DSNXSR.

Copies of Indexes

If you copy a COPY YES index of a table space that has the NOT LOGGED attribute, copy the indexes and table spaces together. Copying the indexes and table spaces together ensures that the indexes and the table space have the same recoverable point.

An index should be image copied after an ALTER INDEX REGENERATE. You should copy the index after it has been rebuilt for these types of ALTER statements:

- alter to padded

- alter to not padded
- alter add of a key column
- alter of a numeric data type key column

Any new partitions added by SQL INSERT are not contained in the image copy, but the newly added partitions are recoverable by the DB2 logs.

When the index has the COMPRESS YES attribute, concurrent copies of indexes and FlashCopy image copies of indexes are compressed because DFSMSdss is invoked to copy the VSAM linear data sets (LDS) for the index. Image copies of indexes are not compressed because the index pages are copied from the DB2 buffer pool. When image copies are taken without the concurrent option, you can choose to compress the image copies by using access method compression via DFSMS or by using IDRC if the image copies reside on tape.

Using DFSMSdss concurrent copy

You might be able to gain improved availability by using the concurrent copy function of the DFSMSdss component of the Data Facility Storage Management Subsystem (DFSMS). To complete recovery, you can subsequently run the DB2 RECOVER utility to restore those image copies and apply the necessary log records to them.

The CONCURRENT option of COPY invokes DFSMSdss concurrent copy. The COPY utility records the resulting DFSMSdss concurrent copies in the catalog table SYSIBM.SYSCOPY with ICTYPE=F and STYPE=C or STYPE=J. STYPE=C indicates that the concurrent copy was taken of the "I" instance of the table space (which means that the instance qualifier in the name of the corresponding data set begins with the letter "I"). STYPE=J indicates that the concurrent copy was taken of the "J" instance of the table space (which means that the instance qualifier in the name of the corresponding data set begins with the letter "J").

To obtain a consistent offline backup copy outside of DB2:

1. Start the DB2 objects that are being backed up for read-only access by issuing the following command:

   ```
   -START DATABASE(database-name) SPACENAM(
   tablespace-name) ACCESS(RO)
   ```

   Allowing read-only access is necessary to ensure that no updates to data occur during this procedure.
2. Run QUIESCE with the WRITE(YES) option to quiesce all DB2 objects that are being backed up.
3. Back up the DB2 data sets after the QUIESCE utility completes successfully.
4. Issue the following command to allow transactions to access the data:

   ```
   -START DATABASE(database-name) SPACENAM(tablespace-name)
   ```

If you use the CONCURRENT option:

- You must supply either a COPYDDN DD name, a RECOVERYDDN DD name, or both. Note that the required JCL parameter specifications for the output data sets for the CONCURRENT option might differ from the JCL specifications required for sequential format data sets. For example, do not specify the BUFNO parameter for the output data sets when specifying the CONCURRENT option.
- You can set the disposition to DISP=(MOD,CATLG,CATLG) if you specify the new data set for the image copy on a scratch volume (a specific volume serial

number is not specified). You must set the disposition to DISP=(NEW,CATLG,CATLG) if you specify a specific volume serial number for the new image copy data set.

- If you are restarting COPY, specify DISP=(MOD,CATLG,CATLG) or DISP=(NEW,CATLG,CATLG) for the COPYDDN and RECOVERYDDN data sets. The DFSMSdss DUMP command does not support appending to an existing data set. Therefore, the COPY utility converts any DISP=MOD data sets to DISP=OLD before invoking DFSMSdss.
- If the SYSPRINT DD statement points to a data set, you must use a DSSPRINT DD statement.
- If the page size in the table space matches the control interval for the associated data set, you can use either the SHRLEVEL CHANGE option or the SHRLEVEL REFERENCE option. If the page size does not match the control interval, you must use the SHRLEVEL REFERENCE option for table spaces with a 8-KB, 16-KB, or 32-KB page size.

Restrictions on using DFSMSdss concurrent copy

You cannot use a copy that is made with DFSMSdss concurrent copy with the PAGE or ERRORRANGE options of the RECOVER utility. If you specify PAGE or ERROR RANGE, RECOVER bypasses any concurrent copy records when searching the SYSIBM.SYSCOPY table for a recovery point.

You can use the CONCURRENT option with SHRLEVEL CHANGE on a table space if the page size in the table space matches the control interval for the associated data set.

Also, you cannot run the following DB2 stand-alone utilities on copies that are made by DFSMSdss concurrent copy:

DSN1COMP
DSN1COPY
DSN1PRNT

You cannot execute the CONCURRENT option from the DB2I Utilities panel or from the DSNU TSO CLIST command.

Requirements for using DFSMSdss concurrent copy

DFSMSdss concurrent copy is enabled by specific hardware. Contact IBM or the vendor for your specific storage product to verify whether your controller or storage server supports the concurrent copy function.

Table space availability

If you specify COPY SHRLEVEL REFERENCE with the CONCURRENT option, and if you want to copy all of the data sets for a list of table spaces to the same dump data set, specify FILTERDDN in your COPY statement to improve table space availability. If you do not specify FILTERDDN, COPY might force DFSMSdss to process the list of table spaces sequentially, which might limit the availability of some of the table spaces that are being copied.

Related concepts:

"How utilities restart with lists" on page 58

Specifying conditional image copies

Use the CHANGELIMIT option of the COPY utility to specify conditional image copies. You can use it to get a report of image copy information about a table space, or you can let DB2 decide whether to take an image copy based on this information.

You cannot use the CHANGELIMIT option for a table space or partition that is defined with TRACKMOD NO. If you change the TRACKMOD option from NO to YES, you must take an image copy before you can use the CHANGELIMIT option. When you change the TRACKMOD option from NO to YES for a nonpartitioned table space, you must take a full image copy by using DSNUM ALL before you can copy using the CHANGELIMIT option.

Obtaining image copy information about a table space

When you specify COPY CHANGELIMIT REPORTONLY, COPY reports image copy information for the table space and recommends the type of copy, if any, to take. The report includes:

- The total number of pages in the table space. This value is the number of pages that are to be copied if a full image copy is taken.
- The number of empty pages, if the table space is segmented.
- The number of changed pages. This value is the number of pages that are to be copied if an incremental image copy is taken.
- The percentage of changed pages.
- The type of image copy that is recommended.

Adding conditional code to your COPY job

You can add conditional code to your jobs so that an incremental or full image copy, or some other step, is performed depending on how much the table space has changed. For example, you can add a conditional MERGECOPY step to create a new full image copy if your COPY job took an incremental copy. COPY CHANGELIMIT uses the following return codes to indicate the degree that a table space or list of table spaces has changed:

1 (informational)
If no CHANGELIMIT was met.

2 (informational)
If the percentage of changed pages is greater than the low CHANGELIMIT and less than the high CHANGELIMIT value.

3 (informational)
If the percentage of changed pages is greater than or equal to the high CHANGELIMIT value.

If you specify multiple COPY control statements in one job step, that job step reports the highest return code from all of the imbedded statements. Basically, the statement with the highest percentage of changed pages determines the return code and the recommended action for the entire list of COPY control statements that are contained in the subsequent job step.

Using conditional copy with generation data groups (GDGs)

For incremental image copies, COPY can avoid allocating empty image copy data sets if your real-time statistics are valid. However, even if your real-time statistics

are not valid and you are using generation data groups (GDGs), you can ensure that COPY does not create any empty image copies by using the following procedure:

When you use generation data groups (GDGs) and need to make an incremental image copy, take the following steps to prevent creating an empty image copy:

1. Include in your job a first step in which you run COPY with CHANGELIMIT REPORTONLY. Set the SYSCOPY DD statement to DD DUMMY so that no output data set is allocated. If you specify REPORTONLY and use a template, DB2 does not dynamically allocate the data set.
2. Add a conditional JCL statement to examine the return code from the COPY CHANGELIMIT REPORTONLY step.
3. Add a second COPY step without CHANGELIMIT REPORTONLY to copy the table space or table space list based on the return code from the second step.

Related information:

"Allocation of sequential image copy data sets"

Allocation of sequential image copy data sets

If you specify the CHANGELIMIT option in the COPY utility control statement, COPY uses real-time statistics to determine when the criteria for CHANGELIMIT is met. If the CHANGELIMIT criteria is not met, COPY avoids allocating the image copy data set.

If you specify the FULL NO option in the COPY utility control statement, COPY uses real-time statistics to determine if a table space has changed pages since the last copy. If the table space has no changed pages, COPY avoids allocating the incremental copy data set.

If the real-time statistics are not valid, the object's space map pages are used to determine whether the CHANGELIMIT criteria is met or, for FULL NO, whether the table space has changed pages. Additionally, if real-time statistics are not used to determine whether the table space has changed pages, the image copy data set is always allocated.

Related concepts:

"Specifying conditional image copies" on page 174

Related tasks:

Setting up your system for real-time statistics (DB2 Performance)

Related reference:

"Syntax and options of the COPY control statement" on page 141

Preparing for recovery by using the COPY utility

To prepare for recovery, you can use the COPY utility to create copies and establish points of recovery.

Use the following guidelines to help you prepare for recovery:

- Consider periodically merging incremental image copies into one copy.

  The RECOVER utility merges all incremental image copies since the last full image copy, and it must have all the image copies available at the same time. If

this requirement is likely to strain your system resources (for example, by demanding more tape units than are available), consider regularly merging multiple image copies into one copy.

Even if you do not periodically merge multiple image copies into one copy, when you do not have enough tape units, RECOVER can still attempt to recover the object. RECOVER dynamically allocates the full image copy and attempts to dynamically allocate all the incremental image copy data sets. If every incremental copy can be allocated, recovery proceeds to merge pages to table spaces and apply the log. If a point is reached where RECOVER cannot allocate an incremental copy, the log RBA of the last successfully allocated data set is noted. Attempts to allocate incremental copies cease, and the merge proceeds with only the allocated data sets. The log is applied from the noted RBA, and the incremental image copies that were not allocated are ignored.

- Create primary and backup image copies after a LOAD or REORG operation with LOG NO when an inline copy is not created. Create these copies, so that if the primary image copy is not available, fallback recovery with the secondary image copy is possible.
- If you use COPY SHRLEVEL REFERENCE to copy a list of referentially related structures, you do not need to quiesce these objects to create a consistent point of recovery. The copy serves as a point of consistency.
- For LOB data, quiesce and copy both the base table space and the LOB table space at the same time to establish a point of consistency for recovery. QUIESCE does not create a recovery point for a LOB table space that contains LOBs that are defined with LOG NO.
- If an index is in informational COPY-pending (ICOPY) status, take a full image copy of the index space so that the RECOVER utility can recover the index space.

  For an index that was defined with the COPY YES attribute the following utilities can place the index in ICOPY status:
  - REORG INDEX
  - REORG TABLESPACE LOG YES or NO
  - LOAD TABLE LOG YES or NO
  - REBUILD INDEX

  After the utility processing completes, take the full image copy. If you need to recover an index of which you did not take a full image copy, use the REBUILD INDEX utility to rebuild the index from data in the table space.
- Take image copies of table spaces with the NOT LOGGED attribute that have been updated since the last full copy.

  These table spaces are placed in ICOPY status. To copy the table spaces that have been updated, run the COPY utility with the SCOPE PENDING option.

Related concepts:

"Point-in-time recovery" on page 494

Related reference:

Chapter 25, "QUIESCE," on page 415

Improving performance

You can improve the performance of the COPY utility by taking certain actions.

You can merge a full image copy and subsequent incremental image copies into a new full copy by running the MERGECOPY utility. After reorganizing a table space, the first image copy **must** be a full image copy.

Do not base the decision of whether to run a full image copy or an incremental image copy on the number of rows that are updated since the last image copy was taken. Instead, base your decision on the percentage of pages that contain at least one updated record (not the number of updated records). Regardless of the size of the table, if more than 50% of the pages contain updated records, use full image copy (this saves the cost of a subsequent MERGECOPY). To find the percentage of changed pages, you can execute COPY with the CHANGELIMIT REPORTONLY option. Alternatively, you can execute COPY CHANGELIMIT to allow COPY to determine whether a full image copy or incremental copy is required.

Using DB2 data compression for table spaces can improve COPY performance because COPY does not decompress data. The performance improvement is proportional to the amount of compression.

Generation data group definitions for the COPY utility

Use generation data groups to hold image copies. Use of generation data groups offers the benefit of automating the allocation of data set names and the deletion of the oldest data set.

When you define the generation data group:

- You can specify that the oldest data set is automatically deleted when the maximum number of data sets is reached. If you do that, make the maximum number large enough to support all recovery requirements. When data sets are deleted, use the MODIFY utility to delete the corresponding rows in SYSIBM.SYSCOPY.
- Make the limit number of generation data sets equal to the number of copies that you want to keep. Use NOEMPTY to avoid deleting all the data sets from the integrated catalog facility catalog when the limit is reached.

Recommendation: Use templates when using generation data groups.

Related concepts:

"Specifying conditional image copies" on page 174

Using DB2 with DFSMS products

You can use DB2 with DFSMS products.

If image copy data sets are managed by HSM or SMS, all data sets are cataloged.

If you plan to use SMS, catalog all image copies. Never maintain cataloged and uncataloged image copies that have the same name.

Image copies on tape

Do not combine a full image copy and incremental image copies for the same table space on one tape volume. If you do, the RECOVER TABLESPACE utility cannot allocate the incremental image copies.

Termination of COPY

You can terminate the COPY utility.

An active or stopped COPY job may be terminated with the **TERM UTILITY** command. However, if you issue **TERM UTILITY** while COPY is in the active or stopped state, DB2 inserts an ICTYPE=T record in the SYSIBM.SYSCOPY catalog table for each object that COPY had started processing, but not yet completed. (Exception: If the COPY utility is already in the UTILTERM phase, the image copy is considered completed.) For copies that are made with SHRLEVEL REFERENCE, some objects in the list might not have an ICTYPE=T record. For SHRLEVEL CHANGE, some objects might have a valid ICTYPE=F, I, or T record, or no record at all. The COPY utility does not allow you to take an incremental image copy if an ICTYPE=T record exists. You must make a full image copy.

Implications of DISP on the DD statement

The result of terminating a COPY job that uses the parameter DISP=(MOD,CATLG,CATLG) varies as follows:

- If only one COPY control statement exists, no row is written to SYSIBM.SYSCOPY, but an image copy data set has been created and is cataloged in the ICF catalog. You should delete that image copy data set.
- If several COPY control statements are in one COPY job step, a row for each successfully completed copy is written to SYSIBM.SYSCOPY. However, all the image copy data sets have been created and cataloged. You should delete all image copy data sets that are not recorded in SYSIBM.SYSCOPY.

Restart of COPY

You can restart the COPY utility.

Recommendation: Use restart current when possible, because it:

- Is valid for full image copies and incremental copies
- Is valid for a single job step with several COPY control statements
- Is valid for a list of objects
- Requires a minimum of re-processing
- Keeps the DB2 catalog and the integrated catalog facility catalog synchronized

If you do **not** use the **TERM UTILITY** command, you can restart a COPY job. COPY jobs with the CONCURRENT option restart from the beginning, and other COPY jobs restart from the last commit point. You cannot use RESTART(PHASE) for any COPY job. If you are restarting a COPY job with uncataloged output data sets, you must specify the appropriate volumes for the job in the JCL or on the TEMPLATE utility statement. Doing so could impact your ability to use implicit restart.

If the recommended procedure is not followed an ABEND 413-1C may occur during restart of the COPY.

Restarting with a new data set

If you define a new output data set for a current restart, complete the following actions before restarting the COPY job:

1. Copy the failed COPY output to the new data set.
2. Delete the old data set.
3. Rename the new data set to use the old data set name.

Restarting COPY after an out-of-space condition

You can also restart COPY from the last commit point after receiving an out-of-space condition.

Related tasks:

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Sample COPY control statements

Use the sample control statements as models for developing your own COPY control statements.

In some cases, you might run a COPY utility job more than once. To avoid duplicate image copy data sets, a DSN qualifier is used in the following examples.

Example 1: Making a full image copy

The following control statement specifies that the COPY utility is to make a full image copy of table space DSN8D11A.DSN8S11E. The copy is to be written to the data set that is defined by the SYSCOPY DD statement in the JCL; SYSCOPY is the default.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU111.COPYTS',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSCOPY  DD DSN=COPY001F.IFDY01,UNIT=SYSDA,VOL=SER=CPY01I,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//SYSIN DD *
COPY TABLESPACE DSN8D11A.DSN8S11E
/*
```

Instead of defining the data sets in the JCL, you can use templates. In the following example, the preceding job is modified to use a template. In this example, the name of the template is LOCALDDN. The LOCALDDN template is identified in the COPY statement by the COPYDDN option.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU111.COPYTS',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN DD *
TEMPLATE LOCALDDN UNIT SYSDA DSN(COPY001F.IFDY01)
          SPACE(15,1) CYL DISP(NEW,CATLG,CATLG)
 COPY TABLESPACE DSN8D81A.DSN8S81E COPYDDN(LOCALDDN)
/*
```

Recommendation: When possible, use templates to allocate data sets.

Example 2: Making full image copies for local site and recovery site

The following COPY control statement specifies that COPY is to make primary and backup full image copies of table space DSN8D11P.DSN8S11C at both the local site and the recovery site. The COPYDDN option specifies the output data sets for the local site, and the RECOVERYDDN option specifies the output data sets for the recovery site. The PARALLEL option indicates that up to 2 objects are to be processed in parallel.

The OPTIONS statement at the beginning indicates that if COPY encounters any errors (return code 8) while making the requested copies, DB2 ignores that particular item. COPY skips that item and moves on to the next item. For example, if DB2 encounters an error copying the specified data set to the COPY1 data set, DB2 ignores the error and tries to copy the table space to the COPY2 data set.

```
OPTIONS EVENT(ITEMERROR,SKIP)
COPY TABLESPACE DSN8D81P.DSN8S81C
   COPYDDN(COPY1,COPY2)
   RECOVERYDDN(COPY3,COPY4)
   PARALLEL(2)
```

Example 3: Making full image copies of a list of objects

The control statement below specifies that COPY is to make local and recovery full image copies (both primary and backup) of the following objects:

- Table space DSN8D11A.DSN8S11D, and its indexes:
  - DSN8B10.XDEPT1
  - DSN8B10.XDEPT2
  - DSN8B10.XDEPT3
- Table space DSN8D11A.DSN8S11E, and its indexes:
  - DSN8710.XEMP1
  - DSN8710.XEMP2

These copies are to be written to the data sets that are identified by the COPYDDN and RECOVERYDDN options for each object. The COPYDDN option specifies the data sets for the copies at the local site, and the RECOVERYDDN option specifies the data sets for the copies at the recovery site. The first parameter of each of these options specifies the data set for the primary copy, and the second parameter specifies the data set for the backup copy. For example, the primary copy of table space DSN8D81A.DSN8S81D at the recovery site is to be written to the data set that is identified by the COPY3 DD statement.

PARALLEL(4) indicates that up to four of these objects can be processed in parallel. As the COPY job of an object completes, the next object in the list begins processing in parallel until all of the objects have been processed.

SHRLEVEL REFERENCE specifies that no updates are allowed during the COPY job. This option is the default and is recommended to ensure the integrity of the data in the image copy.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU111.COPYTS',
//         UTPROC='',
//         SYSTEM='DSN'
//COPY1 DD DSN=C81A.S20001.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY2 DD DSN=C81A.S20001.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY3 DD DSN=C81A.S20001.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY4 DD DSN=C81A.S20001.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY5 DD DSN=C81A.S20002.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY6 DD DSN=C81A.S20002.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY7 DD DSN=C81A.S20002.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY8 DD DSN=C81A.S20002.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
```

```
//COPY1 DD DSN=C81A.S20001.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY2 DD DSN=C81A.S20001.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY3 DD DSN=C81A.S20001.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY4 DD DSN=C81A.S20001.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY5 DD DSN=C81A.S20002.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY6 DD DSN=C81A.S20002.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY7 DD DSN=C81A.S20002.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY8 DD DSN=C81A.S20002.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY9 DD DSN=C81A.S20003.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY10 DD DSN=C81A.S20003.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY11 DD DSN=C81A.S20003.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY12 DD DSN=C81A.S00003.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY13 DD DSN=C81A.S00004.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY14 DD DSN=C81A.S00004.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY15 DD DSN=C81A.S00004.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY16 DD DSN=C81A.S00004.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY17 DD DSN=C81A.S00005.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY18 DD DSN=C81A.S00005.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY19 DD DSN=C81A.S00005.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY20 DD DSN=C81A.S00005.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY21 DD DSN=C81A.S00006.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY22 DD DSN=C81A.S00006.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY23 DD DSN=C81A.S00006.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY24 DD DSN=C81A.S00006.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY25 DD DSN=C81A.S00007.D2003142.T155241.LP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY26 DD DSN=C81A.S00007.D2003142.T155241.LB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY27 DD DSN=C81A.S00007.D2003142.T155241.RP,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//COPY28 DD DSN=C81A.S00007.D2003142.T155241.RB,
//         SPACE=(CYL,(15,1)),DISP=(NEW,CATLG,CATLG)
//SYSIN DD *
 COPY
   TABLESPACE DSN8D11A.DSN8S11D
        COPYDDN (COPY1,COPY2)
        RECOVERYDDN (COPY3,COPY4)
  INDEX DSN8B10.XDEPT1
        COPYDDN (COPY5,COPY6)
        RECOVERYDDN (COPY7,COPY8)
  INDEX DSN8B10.XDEPT2
        COPYDDN (COPY9,COPY10)
        RECOVERYDDN (COPY11,COPY12)
```

```
  INDEX DSN8B10.XDEPT3
       COPYDDN (COPY13,COPY14)
       RECOVERYDDN (COPY15,COPY16)
  TABLESPACE DSN8D11A.DSN8S11E
       COPYDDN (COPY17,COPY18)
       RECOVERYDDN (COPY19,COPY20)
  INDEX DSN8B10.XEMP1
       COPYDDN (COPY21,COPY22)
       RECOVERYDDN (COPY23,COPY24)
  INDEX DSN8B10.XEMP2
       COPYDDN (COPY25,COPY26)
       RECOVERYDDN (COPY27,COPY28)
 PARALLEL(4)
 SHRLEVEL REFERENCE
/*
```

Figure 15. Example of making full image copies of multiple objects

You can also write this COPY job so that it uses lists and templates, as shown below. In this example, the name of the template is T1. Note that this TEMPLATE statement does not contain any space specifications for the dynamically allocated data sets. Instead, DB2 determines the space requirements. The T1 template is identified in the COPY statement by the COPYDDN and RECOVERYDDN options. The name of the list is COPYLIST. This list is identified in the COPY control statement by the LIST option.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU111.COPYTS',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN DD *
TEMPLATE T2 UNIT(SYSDA) SPACE CYL
       DSN(T2.&SN..T&TI..COPY&IC.&LOCREM.)
TEMPLATE T1 UNIT(SYSDA) SPACE CYL
       DSN(T1.&SN..T&TI..COPY&IC.&LOCREM.)
   LIMIT(5 MB,T2)
  LISTDEF COPYLIST
         INCLUDE TABLESPACE DSN8D81A.DSN8S81D
         INCLUDE INDEX DSN8810.XDEPT1
         INCLUDE INDEX DSN8810.XDEPT2
         INCLUDE INDEX DSN8810.XDEPT3
         INCLUDE TABLESPACE DSN8D81A.DSN8S81E
         INCLUDE INDEX DSN8810.XEMP1
         INCLUDE INDEX DSN8810.XEMP2
   COPY LIST COPYLIST COPYDDN(T1,T1)
         RECOVERYDDN(T1,T1)
     PARALLEL(4) SHRLEVEL REFERENCE
/*
```

Figure 16. Example of using a list and template to make full image copies of multiple objects

Example 4: Using template switching

The following TEMPLATE control statement assumes that tables space SMALL.TS occupies 10 cylinders and table space LARGE.TS occupies 100 cylinders. Both COPY statements use the SMALLTP template which specifies a limit of 20 cylinders. Table space SMALL.TS is smaller than this limit so no switching is performed. The output data set for table space SMALL.TS will be allocated on UNIT=SYSALLDA. Table space LARGE.TS is larger than this limit so the template is switched to the LARGETP template. The output data set for table space LARGE.TS will be allocated on UNIT=TAPE.

```
TEMPLATE LARGETP DSN &DB..&TS..D&DA..T&TI. UNIT=TAPE
TEMPLATE SMALLTP DSN &DB..&TS..D&DA..T&TI. UNIT=SYSALLDA LIMIT( 20 CYL, LARGETP )
COPY TABLESPACE SMALL.TS COPYDDN( SMALLTP )
COPY TABLESPACE LARGE.TS COPYDDN( SMALLTP )
```

Note that the DSN option of the TEMPLATE statement identifies the names of the data sets to which the copies are to be written.

Each of the preceding COPY jobs create a point of consistency for the table spaces and their indexes. You can subsequently use the RECOVER utility with the TOLOGPOINT option to recover all of these objects.

Example 5: Making full image copies of a list of objects in parallel on tape

The following COPY control statement specifies that COPY is to make image copies of the specified table spaces and their associated index spaces in parallel and stack the copies on different tape devices.

The PARALLEL 2 option specifies that up to two objects can be processed in parallel. The TAPEUNITS 2 option specifies that up to two tape devices can be dynamically allocated at one time. The COPYDDN option for each object specifies the data set that is to be used for the local image copy. In this example, all of these data sets are dynamically allocated and defined by templates. For example, table space DSN8D81A.DSN8S81D is copied into a data set that is defined by the A1 template.

The TEMPLATE utility control statements define the templates A1 and A2.

```
//COPY2A   EXEC DSNUPROC,SYSTEM=DSN
//SYSIN    DD *
           TEMPLATE A1 DSN(&DB..&SP..COPY1) UNIT CART STACK YES
           TEMPLATE A2 DSN(&DB..&SP..COPY2) UNIT CART STACK YES
COPY PARALLEL 2 TAPEUNITS 2
          TABLESPACE DSN8D81A.DSN8S81D COPYDDN(A1)
          INDEXSPACE DSN8810.XDEPT COPYDDN(A1)
          TABLESPACE DSN8D81A.DSN8S81E COPYDDN(A2)
          INDEXSPACE DSN8810.YDEPT COPYDDN(A2)
```

Although use of templates is recommended, you can also define the output data sets by coding JCL DD statements, as in the following example. This COPY control statement also specifies a list of objects to be processed in parallel, but in this case, the data sets are defined by DD statements. In each DD statement, notice the parameters for the VOLUME option. These values show that the data sets are defined on three different tape devices as follows:

- The first tape device contains data sets that are defined by DD statements DD1 and DD4. (For DD4, the VOLUME option has a value of *.DD1 for the REF parameter.)
- A second tape device contains data sets that are defined by DD statements DD2 and DD3. (For DD3, the VOLUME option has a value of *.DD3 for the REF parameter.)
- A third tape device contains the data set that is defined by DD statement DD5.

The following table spaces are to be processed in parallel on two different tape devices:

- DSN8D81A.DSN8S81D on the device that is defined by the DD1 DD statement and the device that is defined by the DD5 DD statement

- DSN8D81A.DSN8S81E on the device that is defined by the DD2 DD statement

Copying of the following tables spaces must wait until processing has completed for DSN8D81A.DSN8S81D and DSN8D81A.DSN8S81E:

- DSN8D81A.DSN8S81F on the device that is defined by the DD2 DD statement after DSN8D81A.DSN8S81E completes processing
- DSN8D81A.DSN8S81G on the device that is defined by the DD1 DD statement after DSN8D81A.DSN8S81D completes processing

```
//COPY1A   EXEC DSNUPROC,SYSTEM=DSN
//DD1 DD DSN=DB1.TS1.CLP,
//       DISP=(NEW,CATLG,CATLG),
//       UNIT=TAPE,LABEL=(1,SL),
//       VOLUME=(,RETAIN)
//DD2 DD DSN=DB2.TS2.CLP,
//       DISP=(NEW,CATLG,CATLG),
//       UNIT=TAPE,LABEL=(1,SL),
//       VOLUME=(,RETAIN)
//DD3 DD DSN=DB3.TS3.CLB.BACKUP,
//       DISP=(NEW,CATLG,CATLG),
//       UNIT=TAPE,LABEL=(2,SL),
//       VOLUME=(,RETAIN,REF=*.DD2)
//DD4 DD DSN=DB4.TS4.CLB.BACKUP,
//       DISP=(NEW,CATLG,CATLG),
//       UNIT=TAPE,LABEL=(2,SL),
//       VOLUME=(,RETAIN,REF=*.DD1)
//DD5 DD DSN=DB1.TS1.CLB.BACKUP,
//       DISP=(NEW,CATLG,CATLG),
//       UNIT=TAPE,LABEL=(1,SL),
//       VOLUME=(,RETAIN)
 COPY PARALLEL 2 TAPEUNITS 3
      TABLESPACE DSN8D81A.DSN8S81D COPYDDN(DD1,DD5)
      TABLESPACE DSN8D81A.DSN8S81E COPYDDN(DD2)
      TABLESPACE DSN8D81A.DSN8S81F COPYDDN(DD3)
      TABLESPACE DSN8D81A.DSN8S81G COPYDDN(DD4)
```

Figure 17. Example of making full image copies of a list of objects in parallel on tape

Example 6: Using both JCL-defined and template-defined data sets to copy a list of objects on tape

This example uses both JCL DD statements and utility templates to define four data sets for the image copies. The JCL defines two data sets (DB1.TS1.CLP and DB2.TS2.CLB.BACKUP), and the TEMPLATE utility control statements define two data sets that are to be dynamically allocated (&DB..&SP..COPY1 and &DB..&SP..COPY2).

The COPYDDN options in the COPY control statement specify the data sets that are to be used for the local primary and backup image copies of the specified table spaces. For example, the primary copy of table space DSN8D81A.DSN8S71D is to be written to the data set that is defined by the DD1 DD statement (DB1.TS1.CLP), and the primary copy of table space DSN8D81A.DSN8S71E is to be written to the data set that is defined by the A1 template (&DB..&SP..COPY1).

Four tape devices are allocated for this COPY job: the JCL allocates two tape drives, and the TAPEUNITS 2 option in the COPY statement indicates that two tape devices are to be dynamically allocated. Note that the TAPEUNITS option applies only to those tape devices that are dynamically allocated by the TEMPLATE statement.

Recommendation: Although this example shows how to use both templates and DD statements, use only templates, if possible.

```
//COPY1D   EXEC DSNUPROC,SYSTEM=DSN
//DD1 DD DSN=DB1.TS1.CLP,
//       DISP=(,CATLG),
//       UNIT=3490,LABEL=(1,SL)
//       VOLUME=(,RETAIN)
//DD2 DD DSN=DB2.TS2.CLB.BACKUP,
//       DISP=(,CATLG),
//       UNIT=3490,LABEL=(2,SL)
//       VOLUME=(,RETAIN)
//SYSIN    DD *
  TEMPLATE A1 DSN(&DB..&SN..COPY1) UNIT CART STACK YES
  TEMPLATE A2 DSN(&DB..&SN..COPY2) UNIT CART STACK YES
  COPY PARALLEL 2 TAPEUNITS 2
       TABLESPACE DSN8D81A.DSN8S81D COPYDDN(DD1,DD2)
       TABLESPACE DSN8D81A.DSN8S81E COPYDDN(A1,A2)
```

Figure 18. Example of using both JCL-defined and template-defined data sets to copy a list of objects on a tape

Example 7: Using LISTDEF to define a list of objects to copy in parallel to tape

The following example uses the LISTDEF utility to define a list of objects to be copied in parallel to different tape sources. The COPY control statement specifies that the table spaces that are included in the PAYROLL list are to copied. (The PAYROLL list is defined by the LISTDEF control statement.) The TEMPLATE control statements define two output data sets, one for the local primary copy (&DB..&COPY..LOCAL) and one for the recovery primary copy (&DB..&COPY..REMOTE).

```
//COPY3A   EXEC DSNUPROC,SYSTEM=DSN
//SYSIN    DD *
           LISTDEF PAYROLL INCLUDE TABLESPACES TABLESPACE DBPAYROLL.*
           TEMPLATE LOCAL DSN(&DB..&COPY..LOCAL) (+1) UNIT CART STACK YES
           TEMPLATE REMOTE DSN(&DB..&COPY..REMOTE) (+1) UNIT CART STACK YES
           COPY LIST PAYROLL PARALLEL(10) TAPEUNITS(8)
             COPYDDN(LOCAL) RECOVERYDDN(REMOTE)
```

In the preceding example, the utility determines the number of tape streams to use by dividing the value for TAPEUNITS (8) by the number of output data sets (2) for a total of 4 in this example. For each tape stream, the utility attaches one subtask. The list of objects is sorted by size and processed in descending order. The first subtask to finish processes the next object in the list. In this example, the PARALLEL(10) option limits the number of objects to be processed in parallel to 10 and attaches four subtasks. Each subtask copies the objects in the list in parallel to two tape drives, one for the primary and one for the recovery output data sets.

Example 8: Making incremental copies with updates allowed

The FULL NO option in the following COPY control statement specifies that COPY is to make incremental image copies of any specified objects. In this case, the objects to be copied are those objects that are included in the NAME1 list, as indicated by the LIST option. The preceding LISTDEF utility control statement defines the NAME1 list to include index space DSN8D81A.XEMP1 and table space DSN8D81A.DSN8S81D. Although one of the objects to be copied is an index space and COPY does not take incremental image copies of index spaces, the job does

not fail; COPY takes a full image copy of the index space instead. However, if a COPY FULL NO statement identifies only an index that is not part of a list, the COPY job fails.

All specified copies (local primary and backup copies and remote primary and backup copies) are written to data sets that are dynamically allocated according to the specifications of the COPYDS template. This template is defined in the preceding TEMPLATE utility control statement.

The SHRLEVEL CHANGE option in the following COPY control statement specifies that updates can be made during the COPY job.

```
TEMPLATE COPYDS DSN &US.2.&SN..&LR.&PB..D&DATE.
  LISTDEF NAME1 INCLUDE INDEXSPACE DSN8D81A.XEMP1
                INCLUDE TABLESPACE DSN8D81A.DSN8S81D
  COPY LIST NAME1 COPYDDN(COPYDS, COPYDS) RECOVERYDDN(COPYDS,COPYDS)
  FULL NO SHRLEVEL CHANGE
```

Example 9: Making a conditional image copy

The CHANGELIMIT(5) option in the following control statement specifies the following conditions for making an image copy of table space DSN8D81P.DSN8S81C:

- Take a full image copy of the table space if the percentage of changed pages is equal to or greater than 5%.
- Take an incremental image copy of the table space if the percentage of changed pages is greater than 0 and less than 5%.
- Do not take an image copy if no pages have changed.

```
COPY TABLESPACE DSN8D11P.DSN8S11C CHANGELIMIT(5)
```

Example 10: Reporting image copy information for a table space

The REPORTONLY option in the following control statement specifies that image copy information is to be displayed only; no image copies are to be made. The CHANGELIMIT(10,40) option specifies that the following information is to be displayed:

- Recommendation that a full image copy be made if the percentage of changed pages is equal to or greater than 40%.
- Recommendation that an incremental image copy be made if the percentage of changed pages is greater than 10% and less than 40%.
- Recommendation that no image copy be made if the percentage of changed pages is 10% or less.

```
COPY TABLESPACE DSN8D11P.DSN8S11C CHANGELIMIT(10,40) REPORTONLY
```

Example 11: Invoking DFSMSdss concurrent copy

The CONCURRENT option in the following COPY control statement specifies that DFSMSdss concurrent copy is to make a full image copy of the objects in the COPYLIST list (table space DSN8D81A.DSN8S81D and table space DSN8D81A.DSN8S81P). The COPYDDN option indicates that the copy is to be written to the data set that is defined by the SYSCOPY1 template. The DSSPRINT DD statement specifies the data set for message output.

```
//COPY     EXEC DSNUPROC,SYSTEM=DSN
//SYSPRINT DD DSN=COPY1.PRINT1,DISP=(NEW,CATLG,CATLG),
//         SPACE=(4000,(20,20),,,ROUND),UNIT=SYSDA,VOL=SER=DB2CC5
//DSSPRINT DD DSN=COPY1.PRINT2,DISP=(NEW,CATLG,CATLG),
//         SPACE=(4000,(20,20),,,ROUND),UNIT=SYSDA,VOL=SER=DB2CC5
//SYSIN    DD *
  TEMPLATE SYSCOPY1 DSN &DB..&TS..COPY&IC.&LR.&PB..D&DATE..T&TIME.
           UNIT(SYSDA) DISP (MOD,CATLG,CATLG)
  LISTDEF COPYLIST INCLUDE TABLESPACE DSN8D81A.DSN8S81D
                   INCLUDE TABLESPACE DSN8D81A.DSN8S81P
  COPY LIST COPYLIST
  COPYDDN (SYSCOPY1)
  CONCURRENT
```

Figure 19. Example of invoking DFSMSdss concurrent copy with the COPY utility

Example 12: Invoking DFSMSdss concurrent copy and using a filter data set

The control statement specifies that DFSMSdss concurrent copy is to make full image copies of the objects in the TSLIST list (table spaces TS1, TS2, and TS3). The FILTERDDN option specifies that COPY is to use the filter data set that is defined by the FILT template. All output is sent to the SYSCOPY data set, as indicated by the COPYDDN(SYSCOPY) option. SYSCOPY is the default. This data set is defined in the preceding TEMPLATE control statement.

```
LISTDEF TSLIST
        INCLUDE TABLESPACE TS1
        INCLUDE TABLESPACE TS2
        INCLUDE TABLESPACE TS3
TEMPLATE SYSCOPY DSN &DB..&TS..COPY&IC.&LR.&PB..D&DATE..T&TIME.
          UNIT(SYSDA) DISP (MOD,CATLG,CATLG)
TEMPLATE FILT DSN FILT.TEST1.&SN..D&DATE.
          UNIT(SYSDA) DISP (MOD,CATLG,DELETE)
COPY LIST TSLIST
FILTERDDN(FILT)
COPYDDN(SYSCOPY)
CONCURRENT
    SHRLEVEL REFERENCE
```

Figure 20. Example of invoking DFSMSdss concurrent copy with the COPY utility and using a filter data set

Example 13: Copying LOB table spaces together with related objects

Assume that table space TPIQUD01 is a base table space and that table spaces TLIQUDA1, TLIQUDA2, TLIQUDA3, and TLIQUDA4 are LOB table spaces. The control statement specifies that COPY is to take the following actions:

- Take a full image copy of each specified table space if the percentage of changed pages is equal to or greater than the highest decimal percentage value for the CHANGELIMIT option for that table space. For example, if the percentage of changed pages for table space TPIQUD01 is equal to or greater than 6.7%, COPY is to take a full image copy.
- Take an incremental image copy of each specified table space if the percentage of changed pages is in the range between the specified decimal percentage values for the CHANGELIMIT option for that table space. For example, if the percentage of changed pages for table space TLIQUDA1 is greater than 7.9% and less than 25.3%, COPY is to take an incremental image copy.
- Do not take an image copy of each specified table space if the percentage of changed pages is equal to or less than the lowest decimal percentage value for

the CHANGELIMIT option for that table space. For example, if the percentage of changed pages for table space TLIQUDA2 is equal to or less than 2.2%, COPY is not to take an incremental image copy.

- Take full image copies of index spaces IPIQUD01, IXIQUD02, IUIQUD03, IXIQUDA1, IXIQUDA2, IXIQUDA3, and IXIQUDA4.

```
COPY
     TABLESPACE DBIQUD01.TPIQUD01 DSNUM ALL CHANGELIMIT(3.3,6.7)
       COPYDDN(COPYTB1)
     TABLESPACE DBIQUD01.TLIQUDA1 DSNUM ALL CHANGELIMIT(7.9,25.3)
       COPYDDN(COPYTA1)
     TABLESPACE DBIQUD01.TLIQUDA2 DSNUM ALL CHANGELIMIT(2.2,4.3)
       COPYDDN(COPYTA2)
     TABLESPACE DBIQUD01.TLIQUDA3 DSNUM ALL CHANGELIMIT(1.2,9.3)
       COPYDDN(COPYTA3)
     TABLESPACE DBIQUD01.TLIQUDA4 DSNUM ALL CHANGELIMIT(2.2,4.0)
       COPYDDN(COPYTA4)
     INDEXSPACE DBIQUD01.IPIQUD01 DSNUM ALL
       COPYDDN(COPYIX1)
     INDEXSPACE DBIQUD01.IXIQUD02 DSNUM ALL
       COPYDDN(COPYIX2)
     INDEXSPACE DBIQUD01.IUIQUD03 DSNUM ALL
       COPYDDN(COPYIX3)
     INDEXSPACE DBIQUD01.IXIQUDA1 DSNUM ALL
       COPYDDN(COPYIXA1)
     INDEXSPACE DBIQUD01.IXIQUDA2 DSNUM ALL
       COPYDDN(COPYIXA2)
     INDEXSPACE DBIQUD01.IXIQUDA3 DSNUM ALL
       COPYDDN(COPYIXA3)
     INDEXSPACE DBIQUD01.IXIQUDA4 DSNUM ALL
       COPYDDN(COPYIXA4)
 SHRLEVEL REFERENCE
```

Figure 21. Example of copying LOB table spaces together with related objects

Example 14: Using GDGs to make a full image copy

The following control statement specifies that the COPY utility is to make a full image copy of table space DBLT2501.TPLT2501. The local copies are to be written to data sets that are dynamically allocated according to the COPYTEM1 template. The remote copies are to be written to data sets that are dynamically allocated according to the COPYTEM2 template. For both of these templates, the DSN option indicates the name of generation data group JULTU225 and the generation number of +1. (If a GDG base does not already exist, DB2 creates one.) Both of these output data sets are to be modeled after the JULTU255.MODEL data set (as indicated by the MODELDCB option in the TEMPLATE statements).

```
//*************************************************************
//* COMMENT: MAKE A FULL IMAGE COPY OF THE TABLESPACE.
//*          USE A TEMPLATE FOR THE GDG.
//*************************************************************
//STEP2    EXEC DSNUPROC,UID='JULTU225.COPY',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSIN    DD *
   TEMPLATE COPYTEM1
            UNIT SYSDA
            DSN 'JULTU225.GDG.LOCAL.&PB.(+1)'
            MODELDCB JULTU225.MODEL
   TEMPLATE COPYTEM2
            UNIT SYSDA
            DSN 'JULTU225.GDG.REMOTE.&PB.(+1)'
            MODELDCB JULTU225.MODEL
   COPY TABLESPACE DBLT2501.TPLT2501
```

```
        FULL YES
        COPYDDN (COPYTEM1,COPYTEM1)
        RECOVERYDDN (COPYTEM2,COPYTEM2)
        SHRLEVEL REFERENCE
```

Example 15: Copying updated table space data

The following control statement indicates that COPY is to copy only the objects that have been updated. SCOPE PENDING indicates that you want to copy only those objects in COPY-pending or informational COPY-pending status.

```
COPY SHRLEVEL REFERENCE
       TABLESPACE DBIQUD01.TPIQUD01 DSNUM ALL CHANGELIMIT(3.3,6.7)
         COPYDDN(COPYTB1)
       TABLESPACE DBIQUD01.TLIQUDA1 DSNUM ALL CHANGELIMIT(7.9,25.3)
         COPYDDN(COPYTA1)
       TABLESPACE DBIQUD01.TLIQUDA2 DSNUM ALL CHANGELIMIT(2.2,4.3)
         COPYDDN(COPYTA2)
       TABLESPACE DBIQUD01.TLIQUDA3 DSNUM ALL CHANGELIMIT(1.2,9.3)
         COPYDDN(COPYTA3)
       TABLESPACE DBIQUD01.TLIQUDA4 DSNUM ALL CHANGELIMIT(2.2,4.0)
         COPYDDN(COPYTA4)
       INDEXSPACE DBIQUD01.IPIQUD01 DSNUM ALL
         COPYDDN(COPYIX1)PARALLEL(4)
   SCOPE PENDING
/*
```

Example 16: Copying clone table data

The following control statement indicates that COPY is to copy only clone table data in the specified table spaces or indexes.

```
COPY SHRLEVEL REFERENCE CLONE
       TABLESPACE DBIQUD01.TPIQUD01 DSNUM ALL CHANGELIMIT(3.3,6.7)
         COPYDDN(COPYTB1)
       TABLESPACE DBIQUD01.TLIQUDA1 DSNUM ALL CHANGELIMIT(7.9,25.3)
         COPYDDN(COPYTA1)
       TABLESPACE DBIQUD01.TLIQUDA2 DSNUM ALL CHANGELIMIT(2.2,4.3)
         COPYDDN(COPYTA2)
       TABLESPACE DBIQUD01.TLIQUDA3 DSNUM ALL CHANGELIMIT(1.2,9.3)
         COPYDDN(COPYTA3)
       TABLESPACE DBIQUD01.TLIQUDA4 DSNUM ALL CHANGELIMIT(2.2,4.0)
         COPYDDN(COPYTA4)
       INDEXSPACE DBIQUD01.IPIQUD01 DSNUM ALL
         COPYDDN(COPYIX1)
```

Chapter 16. COPYTOCOPY

The COPYTOCOPY online utility makes image copies from an image copy that was taken by the COPY utility. The COPYTOCOPY utility can also make image copies from inline copies that the REORG or LOAD utilities make.

Starting with the local primary copy or a recovery-site primary copy, or a copy created by using FlashCopy technology, COPYTOCOPY can make up to four sequential format copies of one or more of the following types of copies:

- Local primary
- Local backup
- Recovery site primary
- Recovery site backup

You can make both full and incremental image copies of a LOB or XML table space.

You cannot run COPYTOCOPY on concurrent copies.

The RECOVER utility uses the copies when recovering a table space or index space to the most recent time or to a previous time. These copies can also be used by MERGECOPY, UNLOAD, and possibly a subsequent COPYTOCOPY execution.

Output

Output from the COPYTOCOPY utility consists of:

- Up to three sequential data sets that contain the image copy. If the copy base is a FlashCopy, four sequential copies can be made.
- Up to three sequential data sets that contain the image copy.
- Rows in the SYSIBM.SYSCOPY catalog table that describe the image copy data sets that are available to the RECOVER utility. Your installations responsible for ensuring that these data sets are available if the RECOVER utility requests them.

The entries for SYSCOPY columns remain the same as the original entries in the SYSCOPY row when the COPY utility recorded them. The COPYTOCOPY job inserts values in the columns DSNAME, GROUP_MEMBER, JOBNAME, AUTHID, DSVOLSER, and DEVTYPE.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are

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specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- IMAGCOPY privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute COPYTOCOPY, but only on a table space in the DSNDB01 or DSNDB06 database.

Restrictions on running COPYTOCOPY

- COPYTOCOPY does not support the following catalog and directory objects:
  - DSNDB01.SYSUTILX and its indexes
  - DSNDB01.DBD01 and its indexes
  - DSNDB01.SYSDBDXA and its indexes
  - DSNDB06.SYSTSCPY and its indexes
- An image copy from a COPY job with the CONCURRENT option cannot be processed by COPYTOCOPY.
- COPYTOCOPY does not check the recoverability of an object.
- COPYTOCOPY cannot be run on a table space during the period after RECOVER is run to a point in time before materialization of pending definition changes and before REORG is run to complete the point-in-time recovery process.
- COPYTOCOPY does not support a range of partitions within a partitioned table space. Specify individual DSNUM(*n*). From the inline copy, COPYTOCOPY copies only the specified partition into the output image copy data set.

Execution phases of COPYTOCOPY

The COPYTOCOPY utility operates in these phases:

Phase Description

UTILINIT
Performs initialization

CPY2CPY
Copies an image copy

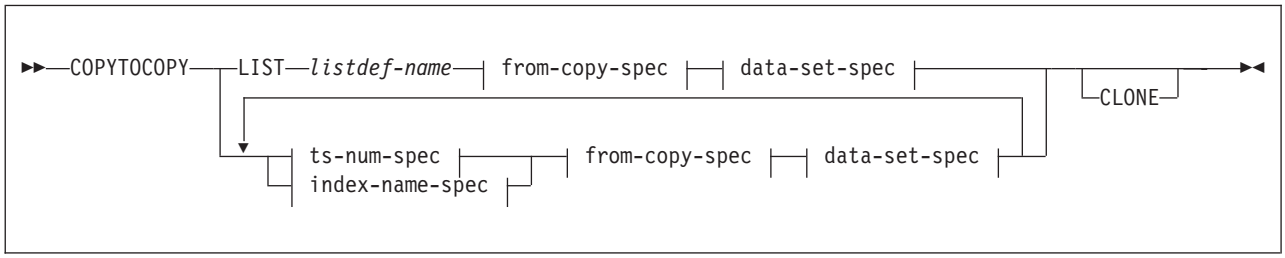
UTILTERM
Performs cleanup

Syntax and options of the COPYTOCOPY control statement

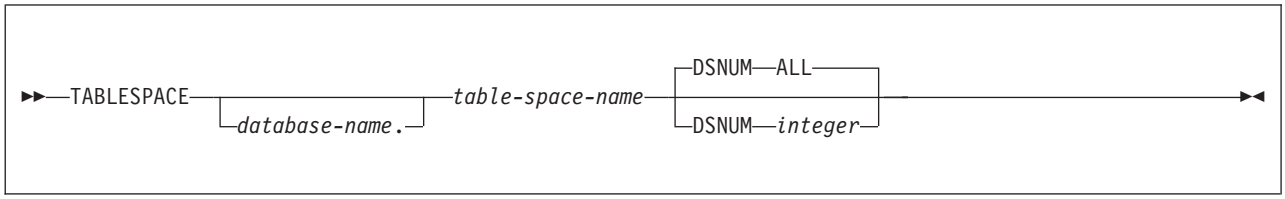
The COPYTOCOPY utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

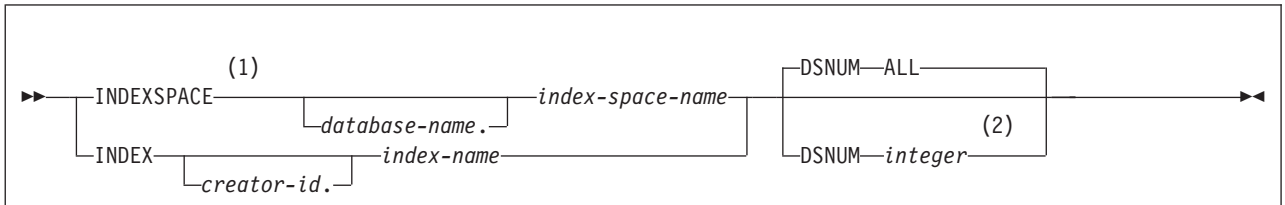
Syntax diagram



ts-num-spec:



index-name-spec:

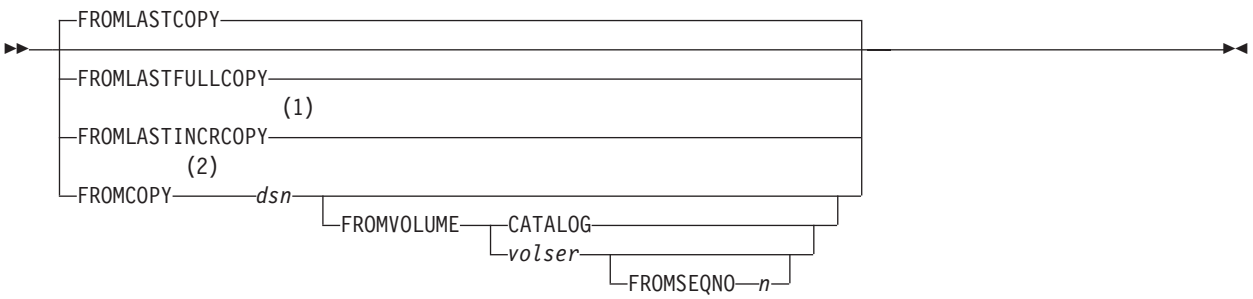


Notes:

1 INDEXSPACE is the preferred specification.

2 Not valid for nonpartitioning indexes.

from-copy-spec:

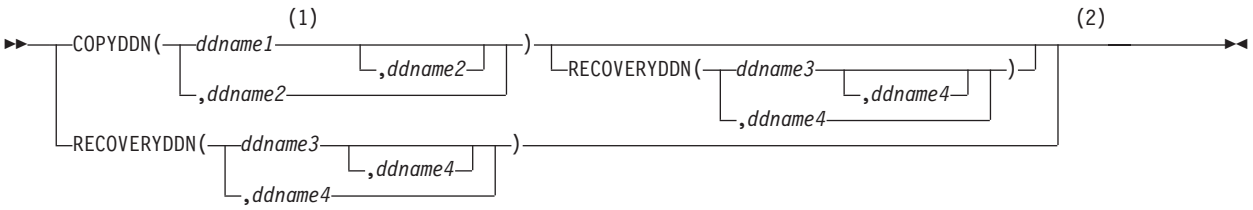


Notes:

1 Not valid with the INDEXSPACE or INDEX keyword.

2 Not valid with the LIST keyword.

data-set-spec:



Notes:

1 Use this option if you want to make a local site primary copy from one of the recovery site copies.

2 You can specify up to three DD names for both the COPYDDN and RECOVERYDDN options combined.

Option descriptions

LIST *listdef-name*

Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each COPYTOCOPY control statement. Do not specify LIST with either the INDEX or TABLESPACE keywords. DB2 invokes COPYTOCOPY once for the entire list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE

Specifies the table space (and, optionally, the database it belongs to) that is to be copied. *database-name* is the name of the database that the table space belongs to. The **default** value is **DSNDB04**.

table-space-name is the name of the table space to be copied.

INDEXSPACE *database-name.index-space-name*
Specifies the qualified name of the index space that is to be copied; the name is obtained from the SYSIBM.SYSINDEXES table. Define the index space with the COPY YES attribute.

database-name optionally specifies the name of the database that the index space belongs to. The **default** value is **DSNDB04**.

index-space-name specifies the name of the index space that is to be copied.

INDEX *creator-id.index-name*
Specifies the index that is to be copied. Enclose the index name in quotation marks if the name contains a blank.

creator-id optionally specifies the creator of the index. The **default** value is the user identifier for the utility.

index-name specifies the name of the index that is to be copied.

DSNUM
Identifies a partition or data set, within the table space or the index space, that is to be copied. The keyword ALL specifies that the entire table space or index space is to be copied.

You cannot specify DSNUM for nonpartitioned indexes.

ALL
Specifies that the entire table space or index space is to be copied. You must use ALL for a nonpartitioned secondary index.

integer
Is the number of a partition or data set that is to be copied.

An integer value is not valid for nonpartitioned secondary indexes.

For a partitioned table space or index space, the integer is its physical partition number. The maximum is 4096.

For a nonpartitioned table space, find the integer at the end of the data set name as cataloged in the VSAM catalog. The data set name has the following format:

catname.DSNDB*x*.*dbname*.*spacename*.*y*000*Z*.A*nnn*

In this format:

catname
Is the VSAM catalog name or alias.

x Is C or D.

dbname
Is the database name.

spacename
Is the table space or index space name.

y Is I or J.

z Is 1 or 2.

nnn Is the data set integer.

Specifying or using the default of DSNUM(ALL) causes COPYTOCOPY to look for an input image copy that was taken at the entire table space or index space level.

FROMLASTCOPY
Specifies the most recent image copy that was taken for the table space or index space that is to be the input to the COPYTOCOPY utility. This could be a full image copy or incremental copy that is retrieved from SYSIBM.SYSCOPY.

FROMLASTFULLCOPY
Specifies the most recent full image copy that was taken for the object, which is to be the input to the COPYTOCOPY job.

FROMLASTINCRCOPY
Specifies the most recent incremental image copy that was taken for the object that is to be the input to COPYTOCOPY job.

FROMLASTINCRCOPY is not valid with the INDEXSPACE or INDEX keyword. If FROMLASTINCRCOPY is specified for an INDEXSPACE or INDEX, COPYTOCOPY uses the last full copy that was taken, if one is available.

FROMCOPY *dsn*
Specifies a particular image copy data set (*dsn*) as the input to the COPYTOCOPY job. This option is not valid for LIST.

If the image copy data set is a generation data set, then supply a fully qualified data set name, including the absolute generation and version number. If the image copy data set is not a generation data set and more than one image copy data set have the same data set name, use the FROMVOLUME option to identify the data set exactly.

FROMVOLUME
Identifies the image copy data set.

CATALOG
Identifies the data set as cataloged. Use this option only for an image copy that was created as a cataloged data set. (Its volume serial is not recorded in SYSIBM.SYSCOPY.)

COPYTOCOPY refers to the SYSIBM.SYSCOPY catalog table during execution. If you use FROMVOLUME CATALOG, the data set must be cataloged. If you remove the data set from the catalog after creating it, you must catalog the data set again to make it consistent with the record that appears in SYSIBM.SYSCOPY for this copy.

vol-ser
Identifies the data set by an alphanumeric volume serial identifier of its first volume. Use this option only for an image copy that was created as a noncataloged data set. Specify the first *vol-ser* in the SYSCOPY record to locate a data set that is stored on multiple tape volumes.If an individual volume serial number contains leading zeros, it must be enclosed in single quotation marks.

FROMSEQNO *n*
Identifies the image copy data set by its file sequence number. *n* is the file sequence number.

COPYDDN (*ddname1***,***ddname2***)**
Specifies a DD name (*ddname*) or a TEMPLATE name for the primary (*ddname1*) and backup (*ddname2*) copied data sets for the image copy at the local site. If *ddname2* is specified by itself, COPYTOCOPY expects the local site primary image copy to exist. If it does not exist, error message DSNU1401 is issued and the process for the object is terminated.

Recommendation: Catalog all of your image copy data sets.

You cannot have duplicate image copy data sets. If the DD statement identifies a noncataloged data set with the same name, volume serial, and file sequence number as one that is already recorded in SYSIBM.SYSCOPY, COPYTOCOPY issues a message and no copy is made. If the DD statement identifies a cataloged data set with only the same name, no copy is made. For cataloged image copy data sets, you must specify CATLG for the normal termination disposition in the DD statement; for example, DISP=(MOD,CATLG,CATLG). The DSVOLSER field of the SYSCOPY entry is blank.

When the image copy data set is going to a tape volume, specify VOL=SER parameter in the DD statement.

The COPYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

RECOVERYDDN (*ddname3***,***ddname4***)**
Specifies a DD name (*ddname*) or a TEMPLATE name for the primary (*ddname3*) and backup (*ddname4*) copied data sets for the image copy at the recovery site. If *ddname4* is specified by itself, COPYTOCOPY expects the recovery site primary image copy to exist. If this image copy does not exist, error message DSNU1401 is issued and the process for the object is terminated.

You cannot have duplicate image copy data sets. The same rules apply for RECOVERYDDN as for COPYDDN.

The RECOVERYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

CLONE
Indicates that COPYTOCOPY is to process only image copy data sets that were taken against clone tables or indexes on clone tables. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

Related reference:

Chapter 35, “TEMPLATE,” on page 789

Chapter 19, “LISTDEF,” on page 221

Data sets that COPYTOCOPY uses

The COPYTOCOPY utility uses a number of data sets during its operation.

The following table describes the data sets that COPYTOCOPY uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 25. Data sets that COPYTOCOPY uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

Table 25. Data sets that COPYTOCOPY uses (continued)

Data set	Description	Required?
Output copies	From one to four output data sets that contain the resulting image copy data sets. Specify their DD names with the COPYDDN and RECOVERYDDN options of the utility control statement.	Yes

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space or Index space
Object that is to be copied. (If you want to copy only certain partitions in a partitioned table space, use the DSNUM option in the control statement.)

DB2 catalog objects
Objects in the catalog that COPYTOCOPY accesses. The utility records each copy in the DB2 catalog table SYSIBM.SYSCOPY.

Input image copy data set
This information is accessed through the DB2 catalog. COPYTOCOPY retains all tape mounts for you. You do not need to code JCL statements to retain tape mounts. If the image copy data sets that are used by COPYTOCOPY reside on the same tape, you do not need to remove the tape.

Output data set size

Image copies are written to sequential non-VSAM data sets.

Recommendation: Use a template for the image copy data set for a table space by specifying a TEMPLATE statement without the SPACE keyword. When you omit this keyword, the utility calculates the appropriate size of the data set for you.

Alternatively, you can find the approximate size, in bytes, of the image copy data set for a table space by using the following procedure:

1. Find the *high-allocated page number* from the COPYPAGESF column of SYSIBM.SYSCOPY or from information in the VSAM catalog data set.
2. Multiply the high-allocated page number by the page size.

Another option is to look at the size of the input image copy.

JCL parameters: You can specify a block size for the output by using the BLKSIZE parameter on the DD statement for the output data set. Valid block sizes are multiples of 4096 bytes. It is recommended that the BLKSIZE parameter be omitted. The TAPEBLKSZLIM parameter of the DEVSUPxx member of SYS1.PARMLIB controls the block size limit for tapes. See the z/OS MVS Initialization and Tuning Guide for more details.

Cataloging image copies

To catalog your image copy data sets, use the DISP=(NEW,CATLG,CATLG) parameter in the DD statement or TEMPLATE that is named by the COPYDDN or RECOVERYDDN option. After the image copy is taken, the DSVOLSER column of the row that is inserted into SYSIBM.SYSCOPY contains blanks.

Duplicate image copy data sets are not allowed. If a cataloged data set is already recorded in SYSIBM.SYSCOPY with the same name as the new image copy data set, a message is issued and the copy is not made.

When RECOVER locates the entry in SYSIBM.SYSCOPY, it uses the ICF catalog to allocate the required data set. If you have uncataloged the data set, the allocation fails. In that case, the recovery can still go forward; RECOVER searches for a previous image copy. But even if RECOVER finds one, it must use correspondingly more of the log to recover. You are responsible for keeping the z/OS catalog consistent with SYSIBM.SYSCOPY with regard to existing image copy data sets.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for COPYTOCOPY

The COPYTOCOPY utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims

The following table shows which claim classes COPYTOCOPY claims on the target object.

Table 26. Claim classes of COPYTOCOPY operations.

Target	COPYTOCOPY
Table space or partition, or index space or partition	UTRW

Legend:
- UTRW - Utility restrictive state - read-write access allowed

Compatibility

The following table documents which utilities can run concurrently with COPYTOCOPY on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also documented in the table.

Table 27. Compatibility of COPYTOCOPY with other utilities

Action	Compatible with COPYTOCOPY?
CHECK DATA	Yes
CHECK INDEX	Yes
CHECK LOB	Yes
COPY	No
DIAGNOSE	Yes
LOAD	No
MERGECOPY	No
MODIFY	No

Table 27. Compatibility of COPYTOCOPY with other utilities (continued)

Action	Compatible with COPYTOCOPY?
QUIESCE	Yes
REBUILD INDEX	Yes
RECOVER	No
REORG INDEX	No
REORG TABLESPACE	No
REPAIR	Yes
REPORT	Yes
RUNSTATS INDEX	Yes
RUNSTATS TABLESPACE	Yes
STOSPACE	Yes
UNLOAD	Yes

Full or incremental image copies with COPYTOCOPY

You can copy a full image copy or an incremental image copy by using FROMLASTCOPY keyword.

If you do not specify FROMLASTCOPY, it will be used by default, as shown in the following example. In this example, the COPYTOCOPY control statement specifies that the utility is to make a backup copy of the most recent full image copy or an incremental image copy of the table space DSN8S11E in database DSN8D11A:

```
COPYTOCOPY TABLESPACE DSN8D11A.DSN8S11E
     COPYDDN(,DDNAME2)
```

The COPYTOCOPY utility makes a copy from an existing image copy and writes pages from the image copy to the output data sets. The JCL for the utility job must include DD statements or a template for the output data sets. If the object consists of multiple data sets and all are copied in one job, the copies reside in one physical sequential output data set.

Incremental image copies with COPYTOCOPY

You can use COPYTOCOPY to make an incremental image copy. An incremental image copy is a copy of the pages that have changed since the last full or incremental image copy.

To make a copy of an incremental image copy, use the keyword FROMLASTINCRCOPY.

The following example control statement specifies that COPYTOCOPY is to make a local site backup image copy, a recovery site primary image copy, and a recovery site backup image copy from an incremental image copy.

```
COPYTOCOPY TABLESPACE DSN8D11A.DSN8S11E
   FROMLASTINCRCOPY
   COPYDDN(,COPY2)
   RECOVERYDDN(COPY3,COPY4)
```

Using more than one COPYTOCOPY statement

You can use more than one control statement for COPYTOCOPY in one DB2 utility job step.

About this task

After each COPYTOCOPY statement executes successfully:
- A row referring to the image copy is recorded in SYSIBM.SYSCOPY table.
- The image copy data set is valid and available for RECOVER, MERGECOPY, COPYTOCOPY, and UNLOAD.

If a job step that contains more than one COPYTOCOPY statement abnormally terminates, do not use TERM UTILITY. Restart the job from the last commit point by using RESTART instead. Terminating COPYTOCOPY in this case might cause inconsistencies between the ICF catalog and DB2 catalogs if generation data sets are used.

Copying from a specific image copy

You can specify a particular image copy that is to be used as input to the COPYTOCOPY utility by using the FROMCOPY option.

Procedure

Invoke the COPYTOCOPY utility with the FROMCOPY keyword. If the input data set is a FlashCopy image copy and the copied object is partitioned, you must also specify the data set number by including the DSNUM option in the control statement. If you specify the FROMCOPY keyword and the specified data set is not found in SYSIBM.SYSCOPY, COPYTOCOPY issues message DSNU1401I. Processing for the object then terminates.

Example

The following control statement specifies that COPYTOCOPY is to make three copies of the table space TPA9031C in database DBA90301 from the image copy data set DH109003.COPY1.STEP1.COPY3:

```
COPYTOCOPY TABLESPACE DBA90301.TPA9031C
   FROMCOPY DH109003.COPY1.STEP1.COPY3
   COPYDDN(,COPY2)
   RECOVERYDDN(COPY3,COPY4)
```

Copying a FlashCopy image copy by using COPYTOCOPY

COPYTOCOPY can create up to four sequential image copies of a FlashCopy image copy. COPYTOCOPY and COPY are the only utilities that can create sequential copies from a FlashCopy image copy.

About this task

Making sequential copies of a FlashCopy image copy is useful if you need to unload data from an image copy. Because the UNLOAD utility does not accept FlashCopy image copies as input, you must first make a sequential copy of the FlashCopy image copy and then unload the data from the sequential copy.

Procedure

To copy a FlashCopy image copy:

In the COPYTOCOPY utility control statement, specify all of the following options:

- FROMCOPY option with the name of VSAM data set that contains the FlashCopy image copy
- DSNUM option with the appropriate data set or partition number for the FlashCopy image copy
- COPYDDN and RECOVERYDDN as needed to indicate which sequential copies you want to create

Related concepts:

"FlashCopy image copies" on page 163

Related tasks:

"Unloading data from image copy data sets" on page 864

Using TEMPLATE with COPYTOCOPY

Template data set name substitution variables resolve as usual. COPYTOCOPY does not use the template values of the original COPY utility execution.

Updating SYSCOPY records

The image copies COPYTOCOPY made are registered in SYSIBM.SYSCOPY for later use by the RECOVER utility. Other utilities can use these copies, too.

Columns that are inserted by COPYTOCOPY are the same as those of the original entries in SYSCOPY row when the COPY utility recorded them. Except for columns GROUP_MEMBER, JOBNAME, AUTHID, DSNAME, DEVTYPE, and DSVOLSER, the columns are those of the COPYTOCOPY job. When COPYTOCOPY is invoked at the partition level (DSNUM *n*) and the input data set is an inline copy that was created by the REORG of a range of partitions, COPYTOCOPY inserts zeros in the HIGHDSNUM and LOWDSNUM columns of the SYSCOPY record.

How COPYTOCOPY determines which input copy to use

The COPYTOCOPY utility makes a copy of an existing image copy. Which image copy the utility uses as input depends on the options that you specify and where you run the utility job.

If you specify the FROMCOPY keyword in the utility control statement, only the specified data set is used as input to the COPYTOCOPY job.

If you do not specify the FROMCOPY keyword, COPYTOCOPY uses the following search order to determine the input data set:

- If you run the utility at the local site, the search order is the local site primary copy, the local site backup copy, the recovery site primary copy, and the recovery site backup copy.
- If you run the utility at the recovery site, the search order is the recovery site primary copy, the recovery site backup copy, the local site primary copy, and the local site backup copy.

If the input data set cannot be allocated or opened, COPYTOCOPY attempts to use the next image copy data set, with the same START_RBA value in the SYSIBM.SYSCOPY catalog table, in the preceding search order.

Related reference:

"Syntax and options of the COPYTOCOPY control statement" on page 192

SYSIBM.SYSCOPY table (DB2 SQL)

Generation data group definitions for the COPYTOCOPY utility

You can use generation data groups to hold image copies. Use of generation data groups offers the benefit of automating allocation of data set names and deletion of the oldest data set. You can also use templates when using generation data groups.

To define the generation group, follow these guidelines:

- Use generation data groups to hold image copies because their use automates the allocation of data set names and the deletion of the oldest data set.
- Use templates when using generation data groups.
- When you define the generation data group:
  - You can specify that the oldest data set is to be automatically deleted when the maximum number of data sets is reached. If you do that, make the maximum number large enough to accommodate all recovery requirements. When data sets are deleted, use the MODIFY utility to delete the corresponding rows in SYSIBM.SYSCOPY.
  - Make the limit number of generation data sets equal to the number of copies that you want to keep. Use NOEMPTY to avoid deleting all the data sets from the integrated catalog facility catalog when the limit is reached.

Using DB2 with DFSMS products

You can use DB2 with DFSMS products.

If image copy data sets are managed by HSM or SMS, all data sets are cataloged.

If you plan to use SMS, catalog all image copies. Never maintain cataloged and uncataloged image copies that have the same name.

Image copies on tape

Do not combine a full image copy and incremental image copies for the same table space on one tape volume. If you do, the RECOVER TABLESPACE utility cannot allocate the incremental image copies.

Copies of lists of objects from tape

The COPYTOCOPY utility determines the number of tape drives to use for the function.

If you use JCL to define tape drives, the JCL allocates tape drives for those definitions. If you use TEMPLATES to allocate tape drives for the output data sets, the utility dynamically allocates the tape drives according to the following algorithm:

- One tape drive if the input data set resides on tape.
- A tape drive for each template with STACK YES that references tape.

- Three tape drives, one for each of the local and remote output image copies, in case non-stacked templates reference tape.

Thus, COPYTOCOPY allocates a minimum of three tape drives. The utility allocates four tape drives if the input data set resides on tape, and more tape drives if you specified tape templates with STACK YES.

If input data sets to be copied are stacked on tape and output data sets are defined by a template, the utility sorts the list of objects by the file sequence numbers (FSN) of the input data sets and processes the objects serially.

Image copies of compressed indexes are copied in uncompressed format, so if you perform COPYTOCOPY using those image copies as input, it will result in uncompressed image copies.

For example, image copies of the following table spaces with their FSNs are stacked on TAPE1:
- DB2.TS1 FSN=1
- DB2.TS2 FSN=2
- DB2.TS3 FSN=3
- DB2.TS4 FSN=4

In the following statements, COPYTOCOPY uses a template for the output data set:

```
//COPYTOCOPY  EXEC DSNUPROC,SYSTEM=V71A
//SYSIN    DD *
TEMPLATE A1 &DB..&SP..COPY1 TAPE UNIT CART STACK YES
            COPYTOCOPY
            TABLESPACE DB1.TS4
                 LASTFULL
                 RECOVERYDDN(A1)
            TABLESPACE DB1.TS1
                 LASTFULL
                   RECOVERYDDN(A1)
            TABLESPACE DB1.TS2
                 LASTFULL
                 RECOVERYDDN(A1)
             TABLESPACE DB1.TS3
                 LASTFULL
                 RECOVERYDDN(A1)
```

As a result, the utility sorts the objects by FSN and processes them in the following order:
- DB1.TS1
- DB1.TS2
- DB1.TS3
- DB1.TS4

If the output data sets are defined by JCL, the utility gives stacking preference to the output data sets over input data sets. If the input data sets are not stacked, the utility sorts the objects by size in descending order.

Termination or restart of COPYTOCOPY

You can terminate or restart the COPYTOCOPY utility.

Termination of COPYTOCOPY

You can use the **TERM UTILITY** command to terminate a COPYTOCOPY job

Restart of a COPYTOCOPY job

If you do **not** use the **TERM UTILITY** command, you can restart a COPYTOCOPY job. COPYTOCOPY jobs restart from the last commit point. You cannot use RESTART(PHASE) for any COPYTOCOPY job. If you are restarting a COPYTOCOPY job with uncataloged output data sets, you must specify the appropriate volumes for the job in the JCL or on the TEMPLATE utility statement. Doing so could impact your ability to use implicit restart.

To prepare for restarting a COPYTOCOPY job, specify DISP=(MOD,CATLG,CATLG) on your DD statements.

Restart of COPYTOCOPY after an out-of-space condition

You can restart COPYTOCOPY from the last commit point after receiving an out-of-space condition.

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Sample COPYTOCOPY control statements

Use the sample control statements as models for developing your own COPYTOCOPY control statements.

Example 1: Making a local backup copy

The following control statement specifies that the COPYTOCOPY utility is to make a local backup copy of the most recent full image copy or incremental image copy, whichever is most recent. The COPYDDN option specifies that the data set for the local site backup image copy is defined by the COPY2 DD statement. Because no data set is specified for the local site primary image copy, which is usually the first parameter of the COPYDDN option, COPYTOCOPY expects this copy to already exist. If it does not exist, DB2 issues an error message and terminates the job.

```
//STEP1    EXEC DSNUPROC,UID='DH109001.COPY1',
//         UTPROC='',
//         SYSTEM='DSN'
//COPY2    DD DSN=DH109001.C2C01.STEP2.COPY2,DISP=(MOD,CATLG,CATLG),
//         SPACE=(1000,(20,20),,,ROUND)
//SYSIN    DD *
   COPYTOCOPY TABLESPACE DBA90101.TLA9011A COPYDDN(,COPY2)
//
```

Example 2: Copying the most recent copy

The following control statement specifies that COPYTOCOPY is to make a local site backup copy, a recovery site primary copy, and a recovery site backup copy of table space DBA90102.TPA9012C. The COPYDDN and RECOVERYDDN options also indicate the data sets to which these copies should be written. For example, the recovery site primary copy is to be written to the COPY3 data set. The

FROMLASTCOPY option specifies that the most recent full image copy or incremental image copy is to be used as the input copy data set. This option is the default and is therefore not required.

```
COPYTOCOPY TABLESPACE DBA90102.TPA9012C
      FROMLASTCOPY COPYDDN(,COPY2)
      RECOVERYDDN(COPY3,COPY4)
```

Example 3: Copying the most recent full image copy

The following control statement specifies that COPYTOCOPY is to make primary and backup copies at the recovery site of table space DBA90201.TPA9021C. The FROMLASTFULLCOPY option specifies that the most recent full image copy is to be used as the input copy data set.

```
COPYTOCOPY TABLESPACE DBA90201.TPA9021C
      FROMLASTFULLCOPY
      RECOVERYDDN(COPY3,COPY4)
```

Example 4: Specifying a copy data set for input

The following control statement specifies that COPYTOCOPY is to make a local site backup copy, a recovery site primary copy, and a recovery site backup copy from data set DH109003.COPY1.STEP1.COPY3. This input data set is specified by the FROMCOPY option. The output data sets (COPY2, COPY3, and COPY4) are specified by the COPYDDN and RECOVERYDDN options.

```
COPYTOCOPY TABLESPACE DBA90301.TPA9031C
      FROMCOPY DH109003.COPY1.STEP1.COPY3
      COPYDDN(,COPY2)
      RECOVERYDDN(COPY3,COPY4)
```

Example 5: Identifying a cataloged image copy data set

The following control statement specifies that COPYTOCOPY is to make a local site backup copy from a cataloged data set that is named DH109003.COPY1.STEP1.COPY4. This data set is identified by the FROMCOPY and FROMVOLUME options. The FROMCOPY option specifies the input data set name, and the FROMVOLUME CATALOG option indicates that the input data set is cataloged. Use the FROMVOLUME option to distinguish a data set from other data sets that have the same name.

```
COPYTOCOPY TABLESPACE DBA90302.TLA9032A
      FROMCOPY DH109003.COPY1.STEP1.COPY4
      FROMVOLUME CATALOG
      COPYDDN(,COPY2)
```

Example 6: Identifying an uncataloged image copy data set

The control statement specifies that COPYTOCOPY is to make a local site backup copy, a recovery site primary copy, and a recovery site backup copy from an uncataloged data set, JUKQU2BP.COPY1.STEP1.TP01. The FROMCOPY option identifies this input data set name, and the FROMVOLUME option identifies the volume (SCR03) for the input data set. Use the FROMVOLUME option to distinguish a data set from other data sets that have the same name. The COPYDDN option identifies the data set for the local site backup copy. This data set is to be dynamically allocated according to the specifications of the C2C1_T1 template, which is defined in one of the preceding TEMPLATE control statements. The RECOVERYDDN option identifies the data sets for the recovery site copies. These data sets are to be dynamically allocated according to the specifications of the C2C1_T2 and C2C1_T3 templates, which are defined in the preceding

TEMPLATE control statements.

```
//STEP1    EXEC DSNUPROC,UID='JUKQU2BP.C2C1',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSIN    DD *

   TEMPLATE C2C1_T1
            DSN(JUKQU2BP.C2C1.LB.&SN.)
            DISP(NEW,CATLG,CATLG)
            UNIT(SYSDA)

   TEMPLATE C2C1_T2
            DSN(JUKQU2BP.C2C1.RP.&SN.)
            DISP(NEW,CATLG,CATLG)
            UNIT(SYSDA)

   TEMPLATE C2C1_T3
            DSN(JUKQU2BP.C2C1.RB.&SN.)
            DISP(NEW,CATLG,CATLG)
            UNIT(SYSDA)

   COPYTOCOPY TABLESPACE DBKQBP01.TPKQBP01
              FROMCOPY JUKQU2BP.COPY1.STEP1.TP01
              FROMVOLUME SCR03
              COPYDDN(,C2C1_T1)
              RECOVERYDDN(C2C1_T2,C2C1_T3)
/*
```

Figure 22. Example of identifying an uncataloged image copy data set

Example 7: Processing a list of objects

The following control statement specifies that COPYTOCOPY is to make local site backup copies of the three partitions of table space DBA90402.TPA9042C that are specified by the DSNUM option (partitions 2, 3, and 4). COPYTOCOPY uses the following input copy data sets, as indicated by the FROMLASTFULLCOPY, FROMLASTCOPY, and FROMLASTINCRCOPY options:

- The most recent full image copy for partition 2
- The most recent full image copy or incremental image copy, whichever is most recent, for partition 3
- The most recent incremental image copy for partition 4

The COPYDDN option for each partition indicates the output data sets (COPY2, COPY3, and COPY4).

```
COPYTOCOPY
      TABLESPACE DBA90402.TPA9042C DSNUM 2
          FROMLASTFULLCOPY COPYDDN(,COPY2)
      TABLESPACE DBA90402.TPA9042C DSNUM 3
          FROMLASTCOPY COPYDDN(,COPY3)
      TABLESPACE DBA90402.TPA9042C DSNUM 4
          FROMLASTINCRCOPY COPYDDN(,COPY4)
```

Example 8: Using LISTDEF and TEMPLATE switching

The following COPYTOCOPY control statement specifies that the utility is to copy the list of objects that are included in the CPY1 list, which is defined by the LISTDEF control statement. The copies are to be written to the data sets that are defined by the T3 template, which is defined in the TEMPLATE control statement. Additionally, T3 template has defined the LIMIT keyword, that is to switch from

T3 template to T4 template if the output data set size is bigger than the specified limit value 5 MB. This template defines the naming convention for the output data sets that are to be dynamically allocated.

The OPTIONS PREVIEW statement before the LISTDEF statement is used to force the CPY1 list contents to be included in the output. For long lists, using this statement is not recommended, because it might cause the output to be too long. The OPTIONS OFF statement ends the PREVIEW mode processing, so that the following TEMPLATE and COPYTOCOPY jobs run normally.

```
OPTIONS PREVIEW
   LISTDEF CPY1 INCLUDE TABLESPACES TABLESPACE DBA906*.T*A906*
            INCLUDE INDEXSPACES COPY YES INDEXSPACE ADMF001.I?A906*
   OPTIONS OFF
 TEMPLATE T4 UNIT(3B0)
      DSN(T4.&SN..T&TI..COPY&IC.&LOCREM.)
   TEMPLATE T3 UNIT(SYSDA) SPACE CYL
      DSN(T3.&SN..T&TI..COPY&IC.&LOCREM.)
        LIMIT(5 MB,T4)
 COPYTOCOPY LIST CPY1 COPYDDN(T3,T3)
```

Example 8: Using LISTDEF and TEMPLATE with the CLONE option

The following COPYTOCOPY control statement specifies that the utility is to copy the list of objects that are included in the C2C1_LIST list, which is defined by the LISTDEF control statement. The CLONE option indicates that COPYTOCOPY is to process only image copy data sets that were taken against clone objects.

```
LISTDEF C2C1_LIST
          INCLUDE TABLESPACES TABLESPACE DBKQBS01.TPKQBS01
          INCLUDE INDEXSPACES INDEXSPACE DBKQBS01.IPKQBS11
          INCLUDE INDEXSPACES INDEXSPACE DBKQBS01.IXKQBS12
          INCLUDE TABLESPACES TABLESPACE DBKQBS02.TSKQBS02
          INCLUDE INDEXSPACES INDEXSPACE DBKQBS02.IXKQBS21
          INCLUDE INDEXSPACES INDEXSPACE DBKQBS02.IXKQBS22

  TEMPLATE C2C1_T1
           DSN(JUKQU2BS.C2C1.LB.&SN.)
           DISP(NEW,CATLG,CATLG)
           UNIT(SYSDA)

  TEMPLATE C2C1_T2
           DSN(JUKQU2BS.C2C1.RP.&SN.)
           DISP(NEW,CATLG,CATLG)
           UNIT(SYSDA)

  TEMPLATE C2C1_T3
           DSN(JUKQU2BS.C2C1.RB.&SN.)
           DISP(NEW,CATLG,CATLG)
           UNIT(SYSDA)

  COPYTOCOPY LIST C2C1_LIST
             FROMLASTFULLCOPY
             COPYDDN(,C2C1_T1)
             RECOVERYDDN(C2C1_T2,C2C1_T3)
             CLONE
```

Chapter 17. DIAGNOSE

The DIAGNOSE online utility generates information that is useful in diagnosing problems. Use this utility only under the direction of IBM Software Support.

Interpreting output

One intended use of this utility is to aid in determining and correcting system problems. When diagnosing DB2 problems, you might need to refer to licensed documentation to interpret output from this utility.

Authorization required

To execute this utility for options which access relational data, you must use a privilege set that includes one of the following authorizations:

- REPAIR privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- DATAACCESS authority
- SQLADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can execute the DIAGNOSE utility on a table space in the DSNDB01 or DSNDB06 database.

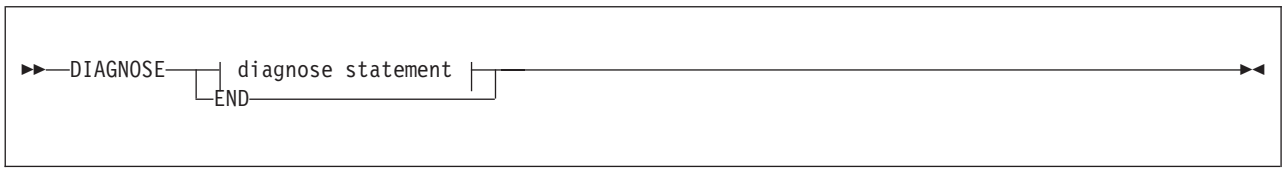
An ID with installation SYSADM authority can execute the DIAGNOSE utility with the WAIT statement option on any table space.

Syntax and options of the DIAGNOSE control statement

The DIAGNOSE utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After you create it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



diagnose statement:

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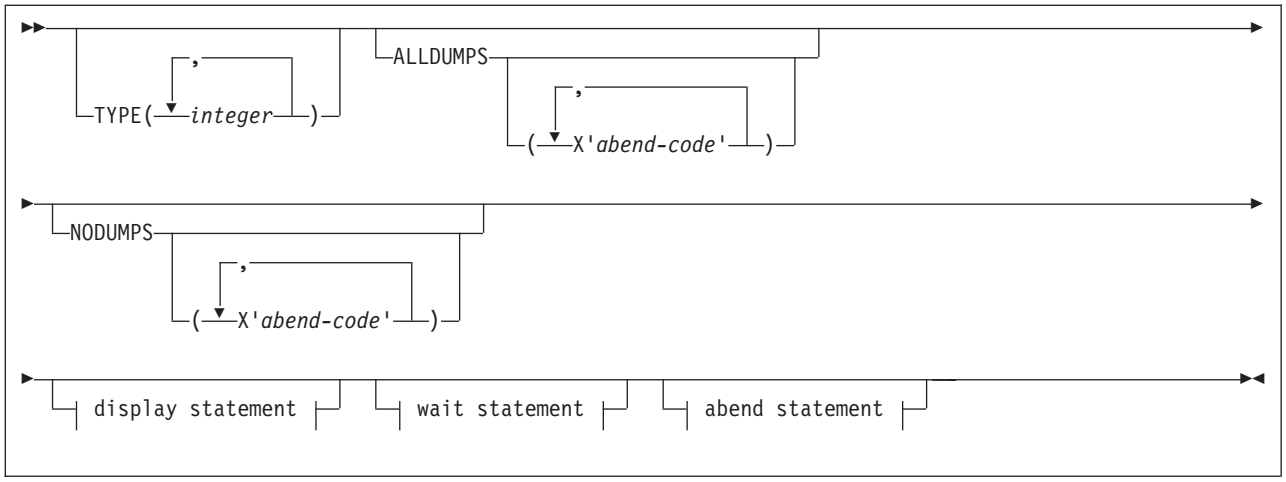
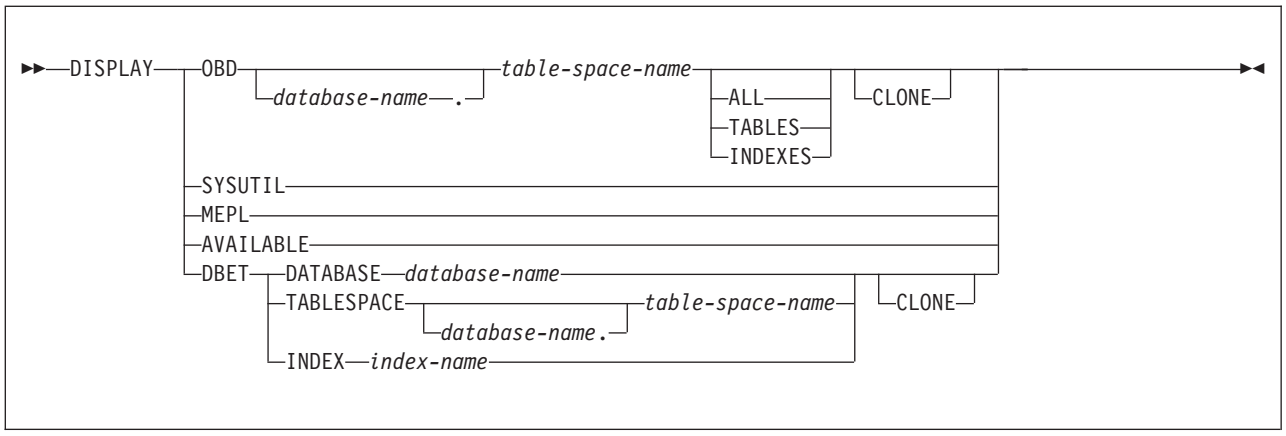
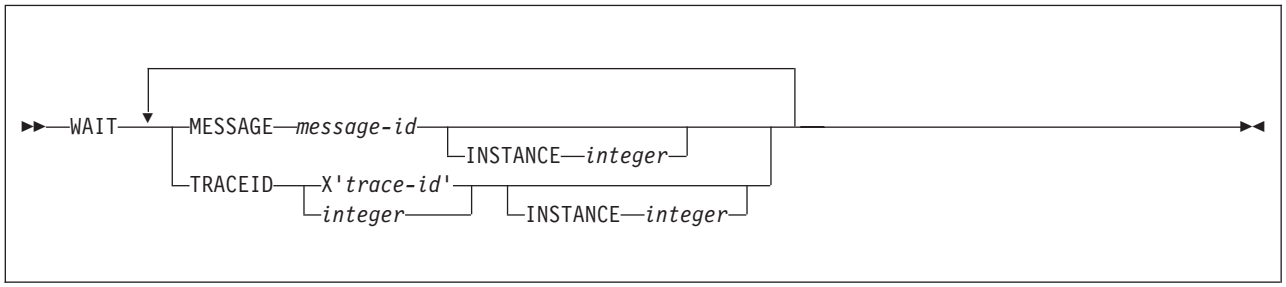


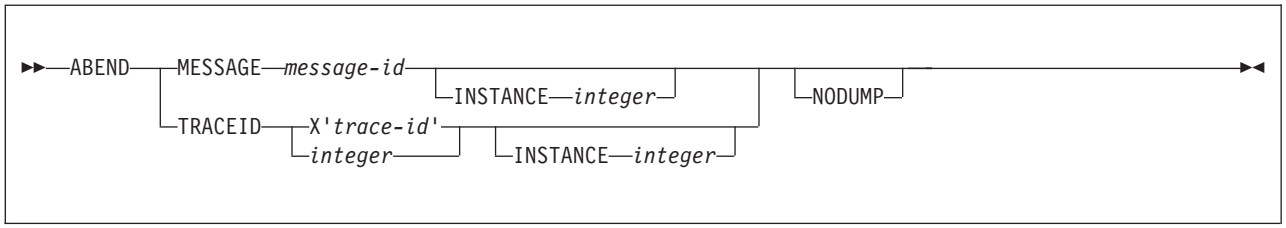
display statement:



wait statement:



abend statement:



Option descriptions

TYPE(*integer***, ...)**
Specifies one or more types of diagnose that you want to perform.

integer is the number of types of diagnoses. The maximum number of types is 32. IBM Software Support defines the types as needed to diagnose problems with IBM utilities.

ALLDUMPS(X'*abend-code***', ...)**
Forces a dump to be taken in response to any utility abend code.

X'*abend-code*' is a member of a list of abend codes to which the scope of ALLDUMPS is limited.

abend-code is a hexadecimal value.

NODUMPS(X'*abend-code***', ...)**
Suppresses the dump for any utility abend code.

X'*abend-code*' is a member of a list of abend codes to which the scope of NODUMPS is limited.

abend-code is a hexadecimal value.

DISPLAY
Formats the specified database items using SYSPRINT.

OBD *database-name.table-space-name*
Formats the object descriptor (OBD) of the table space.

database-name is the name of the database in which the table space belongs.

table-space-name is the name of the table space whose OBD is to be formatted.

ALL
Formats all OBDs of the table space. The OBD of any object that is associated with the table space is also formatted.

TABLES
Formats the OBDs of all tables in the specified table spaces.

INDEXES
Formats the OBDs of all indexes in the specified table spaces.

SYSUTIL
Formats every record from SYSIBM.SYSUTIL. This directory table stores information about all utility jobs.

MEPL
Dumps the module entry point lists (MEPLs) to SYSPRINT.

AVAILABLE
Displays the utilities that are installed on this subsystem in both bitmap and readable format. The presence or absence of the DB2 Utilities Suite for z/OS (5655-W87) affects the results of this display. Message DSNU862I displays the output from DIAGNOSE DISPLAY AVAILABLE.

Related information:

DSNU862I (DB2 Messages)

DBET
Dumps the contents of a database exception table (DBET) to SYSPRINT.

DATABASE *database-name*
Dumps the DBET entry that is associated with the specified database.

database-name is the name of the database.

TABLESPACE *database-name.table-space-name*
Dumps the DBET entry that is associated with the specified table space.

database-name is the name of the database.

table-space-name is the name of the table space.

INDEX *creator-name.index-name*
Dumps the DBET entry that is associated with the specified index.

creator-name is the ID of the creator of the index.

index-name is the name of the index.

Enclose the index name in quotation marks if the name contains a blank.

CLONE
Indicates that DIAGNOSE is to display information for only the following specified objects:

- Clone tables
- Table spaces that contain clone tables
- Indexes on clone tables
- Index spaces that contain indexes on clone tables.

WAIT
Suspends utility execution when it encounters the specified utility message or utility trace ID. DIAGNOSE issues a message to the console. Utility execution does not resume until the operator replies to that message, the utility job times out, or the utility job is canceled. This waiting period allows events to be synchronized while you are diagnosing concurrency problems. The utility waits for the operator to reply to the message, allowing the opportunity to time or synchronize events.

If the utility message or trace ID is not encountered, processing continues.

ABEND
Forces an abend during utility execution if the specified utility message or utility trace ID is issued.

If the utility message or trace ID is not encountered, processing continues

NODUMP
Suppresses the dump that is generated by an abend of DIAGNOSE.

MESSAGE *message-id*
Specifies a DSNU*xxx* or DSNU*xxxx* message that causes a wait or an abend to occur when that message is issued.

message-id is the message, in the form of U*xxx* or U*xxxx*.

INSTANCE *integer*
Specifies that a wait or an abend is to occur when the MESSAGE option message is encountered a specified number of times. If INSTANCE is not specified, a wait or abend occurs each time that the message is encountered.

integer is the number of times that a message is to be encountered before a wait or an abend occurs.

TRACEID *trace-id*
Specifies a trace ID that causes a wait or an abend to occur when the ID is encountered. You can find valid trace IDs can be found in data set *prefix*.SDSNSAMP(DSNWEIDS).

trace-id is a trace ID that is associated with the utility trace (RMID21). You can specify *trace-id* in either decimal (*integer*) or hexadecimal (X'*trace-id*') format.

INSTANCE *integer*
Specifies that a wait or an abend is to occur when the TRACEID option is encountered a specified number of times. If INSTANCE is not specified, a wait or abend occurs each time that the trace ID is encountered.

integer is the number of times that a trace ID is to be encountered before a wait or an abend occurs.

END
Ends DIAGNOSE processing.

Data sets that DIAGNOSE uses

The DIAGNOSE utility uses a number of data sets during its operation.

The following table lists the data sets that DIAGNOSE uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set.

Table 28. Data sets that DIAGNOSE uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Database
Database about which DIAGNOSE is to gather diagnosis information.

Table space
Table space about which DIAGNOSE is to gather diagnosis information.

Index space
Index about which DIAGNOSE is to gather diagnosis information.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for DIAGNOSE

The DIAGNOSE utility has certain concurrency and compatibility characteristics associated with it.

DIAGNOSE can run concurrently on the same target object with any SQL operation or utility, except a utility that is running on DSNDB01.SYSUTILX.

How to force a utility abend

You can force a utility abend by specifying either a message or a trace IFCID in the DIAGNOSE utility control statement.

Procedure

To force utilities to abend, use the following approaches:

- Issue a DIAGNOSE utility control statement. To force an abend when unique-index or referential-constraint violations are detected, you must specify the message that is issued when the error is encountered. Specify this message by using the MESSAGE option of the ABEND statement.
- Instead of using a message, you can force an abend by using the TRACEID option of the ABEND statement to specify a trace IFCID that is associated with the utility to force an abend.
- Use the INSTANCE keyword to specify the number of times that the specified message or trace record is to be generated before the utility abends.

Termination or restart of DIAGNOSE

You can terminate and restart the DIAGNOSE utility.

You can terminate a DIAGNOSE utility job by using the TERM UTILITY command if you submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart a DIAGNOSE utility job, but it starts from the beginning again.

Related tasks:

"Restarting an online utility" on page 52

Sample DIAGNOSE control statements

Use the sample control statements as models for developing your own DIAGNOSE control statements.

Example 1: Displaying DB2 MEPLs

The following DIAGNOSE utility control statement specifies that the DB2 MEPLs are to be displayed. You can use the output from this statement to find the service level of a specific DB2 module. The output lists each module, the most recent PTF or APAR that was applied to the module, and the date that the PTF or APAR was installed.

Important: Specify DB2 load libraries in the JOBLIB or STEPLIB of the DIAGNOSE DISPLAY MEPL job that are at the same maintenance level as the load libraries for the DB2 subsystem on which you execute the utility. Doing this ensures that the information that DIAGNOSE DISPLAY MEPL reports reflects the current state of the DB2 subsystem.

```
DIAGNOSE
 DISPLAY MEPL
```

Example 2: Forcing a dump

The following control statement forces a dump if an abend occurs with either of the following reason codes: X'00E40322' or X'00E40323'.

```
DIAGNOSE
 ALLDUMPS(X'00E40322',X'00E40323')
```

The following control statement forces a dump for any utility abend that occurs during the execution of the specified COPY job. The DIAGNOSE END option ends DIAGNOSE processing.

```
DIAGNOSE
 ALLDUMPS
 COPY TABLESPACE DSNDB06.SYSDDF
DIAGNOSE END
```

Example 3: Performing a diagnosis of a specific type

The control statement in this example specifies that you want to perform a diagnosis of type 66. Run this job under the direction of IBM Software Support to diagnose problems with utility parallelism.

```
//STEP3    EXEC DSNUPROC,UID='JUOSU226.REBUI',
//            UTPROC='',SYSTEM='SSTR'
//SYSIN    DD *
DIAGNOSE TYPE(66)
    REBUILD INDEX (IDOS0302, IDOS0304, IPOS0301)
            SORTDEVT SYSDA SORTNUM 3
DIAGNOSE END
/*
```

Figure 23. Example of diagnosing type 66

Example 4: Forcing a utility abend

The control statement in this example forces an abend of the specified COPY job when one instance of message DSNU400 is issued. The NODUMP option indicates that the DIAGNOSE utility is not to generate a dump in this situation.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU116.COPY1',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSCOPY1  DD DSN=IUJMU116.COPY.STEP1.SYSCOPY1,DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
DIAGNOSE  ABEND MESSAGE U400
                INSTANCE 1
                NODUMP
                   COPY TABLESPACE DSN8D11A.DSN8S11E
                     COPYDDN SYSCOPY1
DIAGNOSE END
//*
```

The following control statement forces an abend of the specified LOAD job when message DSNU311 is issued for the fifth time. The NODUMP option indicates that the DIAGNOSE utility is not to generate a dump in this situation.

```
DIAGNOSE
 ABEND MESSAGE U311 INSTANCE 5 NODUMP
LOAD DATA RESUME NO
  INTO TABLE TABLE1
   (NAME POSITION(1) CHAR(20))
DIAGNOSE END
```

Figure 24. Example of forcing an abend of the COPY utility

Example 5: Suspending utility execution

The control statement in this example indicates that the specified COPYTOCOPY job is to be suspended when it encounters 51 occurrences of the trace ID X'2E6F'.

```
//STEP2    EXEC DSNUPROC,UID='DH109012.C2C01',
//         UTPROC='',
//         SYSTEM='SSTR'
//COPY2    DD DSN=DH109012.C2C01.STEP2.COPY2,DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(1000,(20,20),,,ROUND)
//COPY3    DD DSN=DH109012.C2C01.STEP2.COPY3,DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(1000,(20,20),,,ROUND)
//COPY4    DD DSN=DH109012.C2C01.STEP2.COPY4,DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(1000,(20,20),,,ROUND)
//SYSIN    DD *
   DIAGNOSE WAIT TRACEID X'2E6F' INSTANCE 51
    COPYTOCOPY TABLESPACE DBA91201.TPA91201 DSNUM 1
               FROMLASTFULLCOPY COPYDDN(,COPY2)
                                RECOVERYDDN(COPY3,COPY4)
   DIAGNOSE END
/*
```

Figure 25. Example of suspending utility execution

Example 6: Displaying only CLONE data

The control statement indicates that the DIAGNOSE utility is to be display information for only the specified objects that are table clones, table spaces that contain clone tables, indexes on clone tables, or index spaces that contain indexes on clone tables.

```
DIAGNOSE DISPLAY DBET
     DATABASE DBNI0501
     CLONE
```

Chapter 18. EXEC SQL

The EXEC SQL online utility control statement declares cursors or executes dynamic SQL statements. You can use this utility as part of the DB2 cross-loader function of the LOAD utility.

The cross-loader function enables you to use a single LOAD job to transfer data from one location to another location or from one table to another table at the same location. You can use either a local server or any DRDA-compliant remote server as a data input source for populating your tables. Your input can even come from other sources besides DB2 for z/OS; you can use IBM Information Integrator Federation feature for access to data from sources as diverse as Oracle and Sybase, as well as the entire DB2 family of database servers.

Output

The EXEC SQL control statement produces a result table when you specify a cursor.

Authorization required

The EXEC SQL statement itself requires no privileges to execute. The authorization rules that are defined for the dynamic preparation of the SQL statement specified by EXECUTE IMMEDIATE apply.

Execution phases of EXEC SQL

The EXEC SQL control statement executes entirely in the EXEC phase. You can restart the EXEC phase if necessary.

Related tasks:

"Loading data by using the cross-loader function" on page 331

Related reference:

Statements (DB2 SQL)

Syntax and options of the EXEC SQL control statement

The EXEC SQL utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Utility control statements submitted in UNICODE, including EXEC SQL, are translated into EBCDIC before processing; however, character string constants are not translated. Character string constants are left in the character set in which the were specified. In some cases, you might need to use hexadecimal string constants in order to achieve the behavior that you want.

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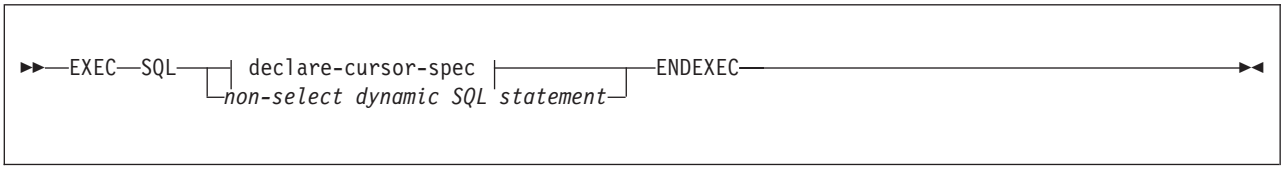
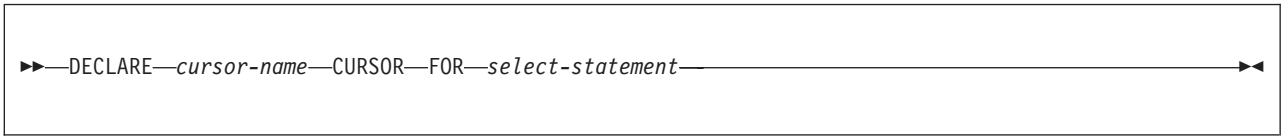
Syntax diagram



declare-cursor-spec:



Option descriptions

cursor-name
Specifies the cursor name. The name must not identify a cursor that is already declared within the same input stream. When using the DB2 cross-loader function to load data from a remote server, you must identify the cursor with a three-part name. Cursor names that are specified with the EXEC SQL utility **cannot be longer than eight characters**.

select-statement
Specifies the result table for the cursor. This statement can be any valid SQL SELECT statement, including joins, unions, conversions, aggregations, special registers, and user-defined functions.

non-select dynamic SQL statement
Specifies a dynamic SQL statement that is to be used as input to EXECUTE IMMEDIATE. You can specify the following dynamic SQL statements in a utility statement:

ALTER
COMMENT ON
COMMIT
CREATE
DELETE
DROP
EXPLAIN
GRANT
INSERT
LABEL ON
LOCK TABLE
RENAME
REVOKE
ROLLBACK
SET CURRENT DECFLOAT ROUNDING MODE
SET CURRENT DEGREE
SET CURRENT LOCALE LC_CTYPE
SET CURRENT OPTIMIZATION HINT
SET PATH
SET CURRENT PRECISION
SET CURRENT RULES
SET CURRENT SQLID
UPDATE

Each SQL statement runs as a separate thread. When the utility executes the SQL statement, the specified statement string is parsed and checked for errors. If the SQL statement is invalid, EXEC SQL does not execute the statement and reports the error condition. If the SQL statement is valid, but an error occurs during execution, EXEC SQL reports that error condition. When an error occurs, the utility terminates.

Related reference:

select-statement (DB2 SQL)

Concurrency and compatibility for EXEC SQL

The EXEC SQL utility has certain concurrency and compatibility characteristics associated with it.

You can use the EXEC SQL control statement with any utility that allows concurrent SQL access on a table space. Other databases are not affected.

Termination or restart of EXEC SQL

You can terminate and restart the EXEC SQL utility.

You can terminate an EXEC SQL utility job by using the TERM UTILITY command if you submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart an EXEC SQL utility job, but it starts from the beginning again. If you are restarting this utility as part of a larger job in which EXEC SQL completed successfully, but a later utility failed, do not change the EXEC SQL utility control statement, if possible. If you must change the EXEC SQL utility control statement, use caution; any changes can cause the restart processing to fail.

Related tasks:

"Restarting an online utility" on page 52

Sample EXEC SQL control statements

Use the sample control statements as models for developing your own EXEC SQL control statements.

Example 1: Creating a table

The following control statement specifies that DB2 is to create table MYEMP with the same rows and columns as sample table EMP.

GUPI

```
EXEC SQL
  CREATE TABLE MYEMP LIKE DSN8B10.EMP CCSID EBCDIC
ENDEXEC
```

GUPI

This type of statement can be used to create a mapping table.

Example 2: Inserting rows into a table

The following control statement specifies that DB2 is to insert all rows from sample table EMP into table MYEMP.

GUPI

```
EXEC SQL
  INSERT INTO MYEMP SELECT * FROM DSN8B10.EMP
ENDEXEC
```

GUPI

Example 3: Declaring a cursor

The following control statement declares C1 as the cursor for a query that is to return all rows from table DSN8810.EMP.

GUPI

```
EXEC SQL
  DECLARE C1 CURSOR FOR SELECT * FROM DSN8B10.EMP
ENDEXEC
```

GUPI

You can use a declared cursor with the DB2 cross-loader function to load data from a local server or from any DRDA-compliant remote server as part of the DB2 cross-loader function.

Related reference:

"Sample REORG TABLESPACE control statements" on page 649

Chapter 19. LISTDEF

The LISTDEF utility enables you to group database objects into reusable lists. You can then specify these lists in other utility control statements to indicate that the utility is to process all of the items in the list.

You can use LISTDEF to standardize object lists and the utility control statements that refer to them. This standardization reduces the need to customize or alter utility job streams.

If you do not use lists and you want to run a utility on multiple objects, you must run the utility multiple times or specify an itemized list of objects in the utility control statement.

Output

Output from the LISTDEF control statement consists of a list with a name.

Authorization required

To execute the LISTDEF utility, you must have SELECT authority on SYSIBM.SYSINDEXES, SYSIBM.SYSTABLES, and SYSIBM.SYSTABLESPACE.

You must use a privilege set that includes one of the following authorities:

- SELECT authority on SYSIBM.SYSINDEXES, SYSIBM. SYSTABLES, and SYSIBM.SYSTABLESPACE
- SQLADM authority
- DATAACCESS authority
- System DBADM authority
- SYSCTRL or SYSADM authority

Additionally, you must have the authority to execute the utility that is used to process the list, as currently documented in the "Authorization required" topic for each utility.

If you do not have authorization to execute the utility on one or more of the items in the list, the utility will stop on the first authorization error. To skip items in the list that return an error, use the OPTIONS (ITEMERROR, SKIP) control statement.

Execution phases of LISTDEF

The LISTDEF control statement executes entirely within the UTILINIT phase.

Syntax and options of the LISTDEF control statement

The LISTDEF utility control statement, with its multiple options, defines a list of table spaces, index spaces, or both on which other utilities can operate.

You can create a control statement with the ISPF/PDF edit function. After you create it, save it in a sequential or partitioned data set. When you create the JCL

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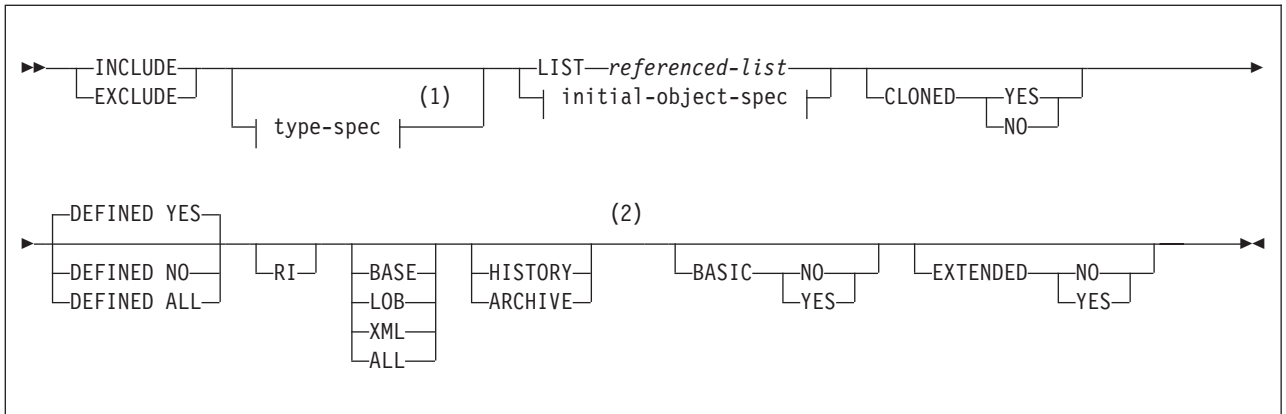
for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram

list-options:

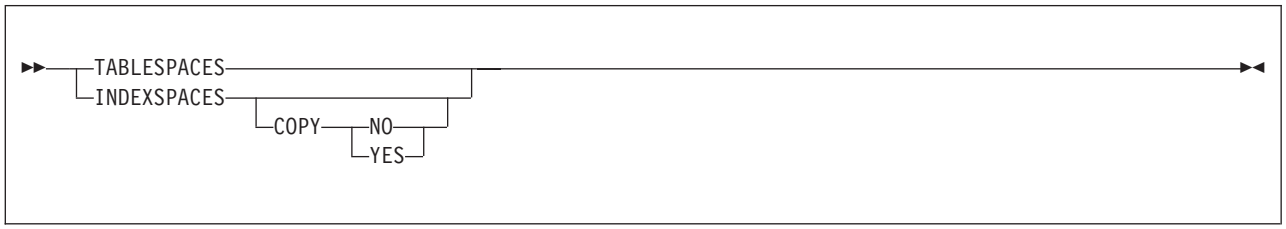


Notes:

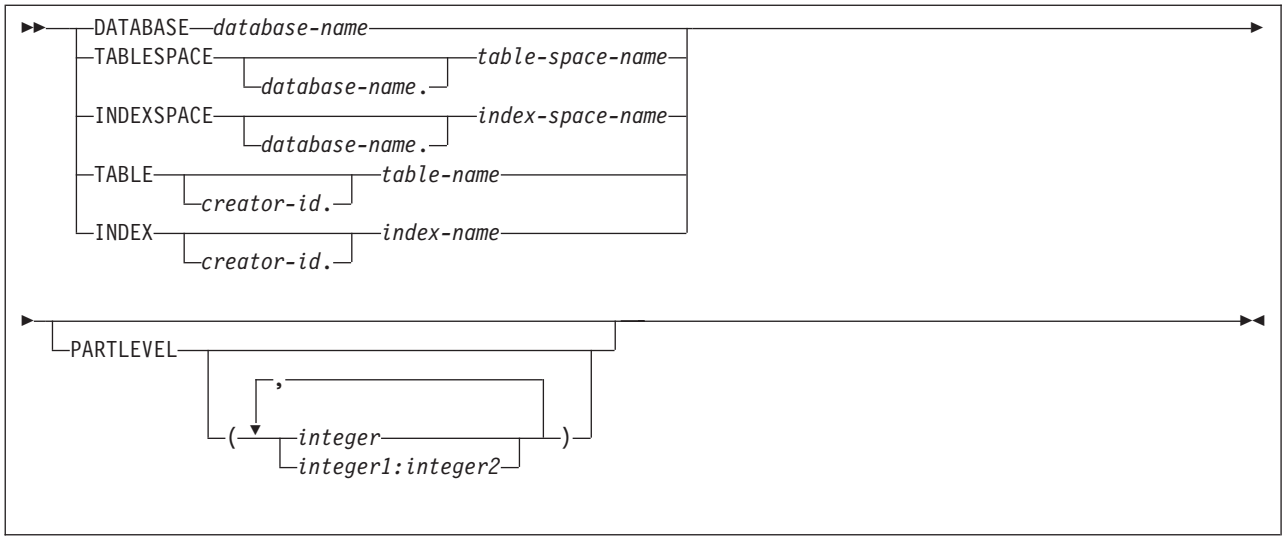
1 You must specify *type-spec* if you specify DATABASE.

2 HISTORY or ARCHIVE can be specified either before or after the BASE, LOB, XML, and ALL keywords. However, HISTORY and ARCHIVE are always processed last, after all other keywords are handled.

type-spec:



initial-object-spec:



Option descriptions

LISTDEF *list-name*

Defines a list of DB2 objects and assigns a name to the list. The list name makes the list available for subsequent execution as the object of a utility control statement or as an element of another LISTDEF statement.

list-name is the name (up to 18 alphanumeric characters in length) of the defined list.

You can put LISTDEF statements either in a separate LISTDEF library data set or before a DB2 utility control statement that references the *list-name*.

INCLUDE

Specifies that the list of objects that results from the expression that follows is to be added to the list. You must first specify an INCLUDE clause. You can then specify subsequent INCLUDE or EXCLUDE clauses in any order to add to or delete clauses from the existing list.

Referencing a large number of databases in a single LISTDEF list might fill the EDM DBD pool and result in an abend 04E with reason code 00C90089. If this situation occurs, decrease the number of databases that are referenced in the LISTDEF statement. If this condition occurs frequently, increase the size of your EDM DBD pool.

Related information:

Calculating EDM pool size (DB2 Installation and Migration)

EXCLUDE

Specifies, after the initial INCLUDE clause, a list of objects to exclude. The expression that follows the EXCLUDE keyword determines this list of objects to exclude. These objects are excluded from the existing LISTDEF list if the objects are already in the list. If the objects are not in the existing list, they are ignored, and DB2 proceeds to the next INCLUDE or EXCLUDE clause.

TABLESPACES

Specifies that the INCLUDE or EXCLUDE object expression is to create a list of related table spaces.

TABLESPACES is the default type for lists that use a table space or a table for the initial search. For more information about specifying these objects, see the descriptions of the TABLESPACE and TABLE options.

No default type value exists for lists that use other lists for the initial search. The list that is reference in the LIST option is used unless you specify TABLESPACES or INDEXSPACES. Likewise, no type default value exists for lists that use databases for the initial search. If you specify the DATABASE option, you must specify INDEXSPACES or TABLESPACES. For more information about specifying lists and databases, see the descriptions of the LIST and DATABASE options.

The result of the TABLESPACES keyword varies depending on the type of object that you specify in the INCLUDE or EXCLUDE clause. These results are shown in The following table.

Table 29. Result of the TABLESPACES keyword based on the object type that is specified in the INCLUDE or EXCLUDE clause.

Object type that is specified in INCLUDE or EXCLUDE clause	Result of the TABLESPACES keyword
DATABASE	Returns all table spaces that are contained within the database
TABLESPACE	Returns the specified table space
TABLE	Returns the table space that contains the table
INDEXSPACE	Returns the table space that contains the related table
INDEX	Returns the table space that contains the related table
LIST of table spaces	Returns the table spaces from the expanded referenced list
LIST of index spaces	Returns the related table spaces for the index spaces in the expanded referenced list
LIST of table spaces and index spaces	Returns the table spaces from the expanded referenced list and the related table spaces for the index spaces in the same list

INDEXSPACES

Specifies that the INCLUDE or EXCLUDE object expression is to create a list of related index spaces.

INDEXSPACES is the default type for lists that use an index space or an index for the initial search. For more information about specifying these objects, see the descriptions of the INDEXSPACE and INDEX options.

No default type value exists for lists that use other lists for the initial search. The list that is referenced in the LIST option is used unless you specify TABLESPACES or INDEXSPACES. Likewise, no type default value exists for lists that use databases for the initial search. If you specify the DATABASE option, you must specify INDEXSPACES or TABLESPACES. For more information about specifying lists and databases, see the descriptions of the LIST and DATABASE options.

The result of the INDEXSPACES keyword varies depending on the type of object that you specify in the INCLUDE or EXCLUDE clause. These results are shown in The following table.

Table 30. Result of the INDEXSPACES keyword based on the object type that is specified in the INCLUDE or EXCLUDE clause.

Object type that is specified in INCLUDE or EXCLUDE clause	Result of the INDEXSPACES keyword
DATABASE	Returns all index spaces that are contained within the database
TABLESPACE	Returns all index spaces for indexes over all tables in the table space
TABLE	Returns all index spaces for indexes over the table
INDEXSPACE	Returns the specified index space.
INDEX	Returns the index space that contains the index
LIST of table spaces	Returns the related index spaces for the table spaces in the expanded referenced list
LIST of index spaces	Returns the index spaces from the expanded referenced list
LIST of table spaces and index spaces	Returns the index spaces from the expanded referenced list and the related index spaces for the table spaces in the same list

COPY

Specifies whether indexes with COPY YES or COPY NO attributes are to be included or excluded in this portion of the list. If you omit COPY, all index spaces that satisfy the INCLUDE or EXCLUDE expression, regardless of their COPY attribute, are included or excluded in this portion of the list. If specified, this keyword must immediately follow the INDEXSPACES keyword. If you specify this keyword elsewhere, it is interpreted as the start of the COPY utility control statement.

YES

Specifies that only index spaces that were defined with or altered to COPY YES are to be included in this portion of the list. Use INCLUDE with COPY YES to develop a list of index spaces that the COPY utility can process.

NO Specifies that only index spaces that were defined with or altered to COPY NO are to be included in this portion of the list. Use EXCLUDE with COPY NO to remove indexes that the COPY utility cannot process from a larger list.

LIST *referenced-list*

Specifies the name of a previously defined object list that is to be expanded and used for the initial search for the object.

referenced-list is the name of the list. You must explicitly specify this name. You cannot specify pattern-matching characters (%,*, ?, and _) for lists.

No default type value exists for lists that are developed from the LIST option. The list is expanded as defined, and it is then modified by subsequent keywords, if any.

You can specify a *type-spec* of TABLESPACES to create a list of only table spaces. If the list to be processed contains index spaces, the TABLESPACES keyword creates a list that includes related table spaces.

You can specify a *type-spec* of INDEXSPACES to create a list of only index spaces. If the list to be processed contains table spaces, the INDEXSPACES keyword creates a list that includes related index spaces.

You can use the LIST keyword to perform any of the following actions:

- Make aggregate lists of lists
- Exclude entire lists from other lists
- Develop lists of objects that are related to other lists

The partitions or partition ranges can be specified in a list.

DATABASE *database-name*
Specifies the database that is to be used for the initial search for the object.

You can specify the *database-name* explicitly or as a pattern-matched name. `DATABASE *` and `DATABASE %` are not supported.

If you specify DATABASE, you must also specify either TABLESPACES or INDEXSPACES as the list type. Depending on the list type that you specify, DB2 includes all table spaces or index spaces in *database-name* that satisfy the pattern-matching expression in the list.

You cannot specify DSNDB01, DSNDB06, DSNDB07, or user-defined work file databases in a LISTDEF.

Use caution when you specify an implicit DATABASE name. Authorization to access objects that are within an implicit database is not uniform. Use the OPTIONS EVENT (ITEMERROR, SKIP) control statement to continue processing when authorization errors occur.

TABLESPACE *database-name.table-space-name*
Specifies the table space that is to be used for the initial search for the object.

If you specify TABLESPACE, the default list type is TABLESPACES. All table spaces that satisfy the pattern-matching expression are included in the list unless the list is modified by other keywords. `TABLESPACE *.*` and `TABLESPACE %.%` are not supported.

database-name specifies the name of the database to which the table space belongs. The default value is **DSNDB04**.

table-space-name specifies the name of the table space.

You can explicitly specify or use pattern-matching characters to specify *database-name*, *table-space-name*, or both.

You cannot include any objects in DSNDB07 or any user-defined work file databases in a LISTDEF. Pattern matching is not supported for DSNDB01 and DSNDB06 objects.

INDEXSPACE *database-name.index-space-name*
Specifies the index space that is to be used for the initial search for the object.

If you specify INDEXSPACE, the default list type is INDEXSPACES. All index spaces that satisfy the pattern-matching expression are included in the list unless the index spaces are excluded by other LISTDEF options. `INDEXSPACE *.*` and `INDEXSPACE %.%` are not supported.

database-name specifies the name of the database to which the index space belongs. The default value is **DSNDB04**.

index-space-name specifies the name of the index space.

You can explicitly specify or use pattern-matching characters to specify *database-name*, *index-space-name*, or both.

You cannot include any objects in DSNDB07 or any user-defined work file databases in a LISTDEF. Pattern-matching is not supported for DSNDB01 and DSNDB06 objects.

TABLE *creator-id.table-name*

Specifies the table that is to be used for the initial search for the object.

If you specify TABLE, the default list type is TABLESPACES. All table spaces that contain tables that satisfy the pattern-matching expression are included in the list unless the list is modified by other keywords. `TABLE *.*` and `TABLE %.%` are not supported.

creator-id specifies the qualifier creator ID for the table. The default value is the user identifier for the utility. *table-name* specifies the name of the table. If you specify a table name with CLONED, the CLONED keyword is ignored.

You can explicitly specify or use pattern-matching characters to specify *creator-id*,*table-name*, or both. However, the underscore pattern-matching character is ignored in a table name.

Pattern-matching is not supported for catalog and directory objects. In a LISTDEF statement, you must include catalog and directory objects by their fully qualified names.

Enclose the table name in quotation marks if the name contains a blank.

INDEX *creator-id.index-name*

Specifies the index that is to be used for the initial search for the object.

If you specify INDEX, the default list type is INDEXSPACES. All index spaces that contain indexes that satisfy the pattern-matching expression are included in the list unless the list is modified by other keywords. `INDEX *.*` and `INDEX %.%` are not supported.

creator-id specifies the qualifier creator ID for the index. The default value is the user identifier for the utility.

index-name specifies the name of the index.

Enclose the index name in quotation marks if the name contains a blank.

You can explicitly specify or use pattern-matching characters to specify *creator-id*, *index-name*, or both. However, the underscore pattern-matching character is ignored in an index name.

Pattern-matching is not supported for catalog and directory objects. In a LISTDEF statement, you must include catalog and directory objects by their fully qualified names.

PARTLEVEL

Specifies the partition granularity for partitioned table spaces, partitioning indexes, and data-partitioned secondary indexes that are to be contained in the list. You cannot specify the PARTLEVEL keyword with the RI keyword.

(*integer***)**

integer is the physical partition number where *integer* >= 0.

If you specify PARTLEVEL 0, the resulting list contains one entry for each nonpartitioned object.

If you specify PARTLEVEL with a nonzero operand, the resulting list contains one entry for the specified partition for partitioned objects and one entry for each nonpartitioned object.

If you specify PARTLEVEL without (*integer*), the resulting list contains one entry for each partition in the partitioned object and one entry for each nonpartitioned object.

(*integer1:integer2***)**

integer1:integer2 indicates the physical partitions or a range of partitions to be specified in a list. The partition range must follow these guidelines:

- *integer1* >= 1
- *integer1* < *integer2*

An INCLUDE with the PARTLEVEL keyword can be removed from the list only by an EXCLUDE with PARTLEVEL.

For partition-by-growth objects, the PARTLEVEL keyword results in an entry for each partition that exists when the LISTDEF list is evaluated. Partitions that are added after the list is evaluated are not included in the list. If a partition is added during long-running job steps in which the list is reused, the partitions that were added are not included in the list and not processed. If a utility job that uses a PARTLEVEL list is restarted, the original list is saved during the original execution for a later restart. The list does not include any added partitions.

CLONED

Use the CLONED keyword to have LISTDEF perform a final filtering of the INCLUDE or EXCLUDE clause contents based on the existence or absence of clone data. This operation is performed last, after LISTDEF processes all other keywords on the INCLUDE or EXCLUDE clause.

CLONED YES specifies that only table spaces and index spaces that contain cloned objects are to be returned in the INCLUDE or EXCLUDE clause. CLONED NO specifies that only table spaces and index spaces that do not contain cloned objects are to be returned in the INCLUDE or EXCLUDE clause. Omit the CLONED keyword if the existence of clone data is not a factor.

The use of CLONED YES or CLONED NO affects only the contents of the list. It does not determine whether clone or base data is later processed by the utility that uses the list. Only the presence or absence of the CLONE keyword on individual utility control statements determines whether clone or base data is processed.

DEFINED

Specifies whether table spaces or index spaces with defined or undefined data sets are to be returned in the INCLUDED or EXCLUDE clause. If you omit the DEFINED keyword, DEFINED YES is the default.

YES

Specifies that only table spaces or index spaces that are currently defined are to be included in the INCLUDED or EXCLUDED clause.

YES is the default if DEFINED is not specified. By default, only defined objects are included in the list. Before DB2 Version 10, the DEFINED keyword did not exist and all objects, both defined and undefined, were included in the list. Specify DEFINED ALL to get the behavior of Version 9 and earlier.

NO Specifies that only table spaces or index spaces that are currently undefined are included in the INCLUDED or EXCLUDED clause. Use EXCLUDE with DEFINED NO to remove table spaces and index spaces that are currently undefined and would not normally be processed by the utility. If you specify DEFINED NO, you cannot specify CLONED YES.

ALL

Specifies that table spaces or index spaces that are both undefined and defined are to be included in the INCLUDED or EXCLUDED clause.

Before DB2 Version 10, the DEFINED keyword did not exist and all objects, both defined and undefined, were included in the list. Specify DEFINED ALL to get the behavior of Version 9 and earlier.

RI Specifies that all objects that are referentially related to the object expression (PRIMARY KEY <--> FOREIGN KEY) are to be included in the list. DB2 processes all referential relationships repeatedly until the entire referential set is developed. You cannot specify RI with PARTLEVEL(*n*).

Auxiliary indicator keywords: Use one of four auxiliary indicator keywords to direct LISTDEF processing to follow auxiliary relationships to include related LOB or XML objects in the list. The auxiliary relationship can be followed in either direction. Auxiliary objects include the auxiliary table spaces, auxiliary tables, indexes on auxiliary tables, and their containing index spaces.

Incomplete LOB or XML definitions cause seemingly related objects to not be found. The auxiliary relationship does not exist until you create the AUX TABLE with the STORES keyword.

No default auxiliary indicator keyword exists. If you do not specify BASE, LOB, XML, or ALL, DB2 does not follow the auxiliary relationships.

ALL

Specifies that BASE, LOB, and XML objects are to be included in the list. Auxiliary relationships are followed from all objects that result from the initial object lookup. BASE, LOB, and XML objects remain in the final enumerated list.

The behavior of the ALL keyword is altered by the presence or absence of the HISTORY or ARCHIVE keywords. When ALL is specified with HISTORY, the resulting list clause contains all related history objects. When ALL is specified with ARCHIVE, the resulting list clause contains all related archive objects (table spaces and index spaces that contain archive tables and their related indexes). When ALL is specified without HISTORY or ARCHIVE, the resulting list clause contains all related objects that are not history or archive objects.

BASE

Specifies that only base table spaces (non-LOB, non-XML) and index spaces are to be included in this element of the list. If the result of the initial search for the object is a base object, auxiliary relationships are not followed. If the result of the initial search for the object is a LOB or XML object, the auxiliary relationship is applied to the base table space or index space. Only those base objects become part of the resulting list.

The behavior of the BASE keyword is altered by the presence or absence of the HISTORY or ARCHIVE keywords. When BASE is specified with HISTORY, the resulting list clause contains only base history objects. When BASE is specified with ARCHIVE, the resulting list clause contains only base archive objects (base table spaces and index spaces that contain archive tables and their related indexes). When BASE is specified without HISTORY or ARCHIVE, the resulting list clause contains only base objects that are not history or archive objects.

LOB

Specifies that only LOB table spaces and related index spaces that contain indexes on auxiliary tables are to be included in this element of the list. If the result of the initial search for the object is a LOB object, auxiliary relationships are not followed. If the result of the initial search for the object is a base object,

the auxiliary relationship is applied to the LOB table space or index space. Only those LOB objects become part of the resulting list.

The behavior of the LOB keyword is altered by the presence or absence of the HISTORY or ARCHIVE keywords. When LOB is specified with HISTORY, the resulting list clause contains only LOB history objects (LOB table spaces and index spaces for history tables). When LOB is specified with ARCHIVE, the resulting list clause contains only LOB archive objects (LOB table spaces and index spaces for archive tables). When LOB is specified without HISTORY or ARCHIVE , the resulting list clause contains only LOB objects that are not history or archive objects.

XML
Specifies that only XML table spaces and related index spaces that contain indexes on auxiliary tables are to be included in this element of the list. If the result of the initial search for the object is an XML object, auxiliary relationships are not followed. If the result of the initial search for the object is a base object, the auxiliary relationship is applied to the XML table space or index space. Only those XML objects become part of the resulting list.

The behavior of the XML keyword is altered by the presence or absence of the HISTORY or ARCHIVE keywords. When XML is specified with HISTORY, the resulting list clause contains only XML history objects (XML table spaces and index spaces for history tables). When XML is specified with ARCHIVE, the resulting list clause contains only XML archive objects (XML table spaces and index spaces for archive tables). When XML is specified without HISTORY or ARCHIVE, the resulting list clause contains only XML objects that are not history or archive objects.

HISTORY
Specifies that only history (versioning) objects are to be included in the resulting list clause.

HISTORY is a filtering keyword that operates against the list clause contents after other keywords are applied. Use the keywords BASE, LOB, XML, or ALL with or without the HISTORY keyword to reference related objects. The order in which these keywords are specified has no meaning. Two INCLUDE or EXCLUDE clauses are required if both history and non-history objects are required.

ARCHIVE
Specifies that only archive objects are to be included in the resulting list clause.

ARCHIVE is a filtering keyword that operates against the list clause contents after other keywords are applied. Use the BASE, LOB, XML, or ALL keywords with or without the ARCHIVE keyword to reference related objects. The order in which these keywords are specified has no meaning. Two INCLUDE or EXCLUDE clauses are required if both archive and non-archive objects are required.

ARCHIVE cannot be specified with the HISTORY or CLONED YES keywords

Related information:

Archive-enabled tables and archive tables (Introduction to DB2 for z/OS)

BASIC
Specifies that LISTDEF is to perform a final filtering of the INCLUDE or EXCLUDE clause contents based on the basic format with 6-byte RBA or LRSN values. This operation is performed last, after LISTDEF processes all other keywords on the INCLUDE or EXCLUDE clause.

YES
Specifies that only table spaces and index spaces that are in basic format with 6-byte RBA or LRSN values are to be returned in the INCLUDE or EXCLUDE clause. This option is the same as EXTENDED NO.

NO Specifies that only table spaces and index spaces that are not in basic format with 6-byte RBA or LRSN values format are to be returned in the INCLUDE or EXCLUDE clause. This option is the same as EXTENDED YES.

The BASIC keyword does not have a default value. If the RBA or LRSN format is not a factor, omit the BASIC and EXTENDED keywords.

If the clause also includes the PARTLEVEL keyword with either a non-zero operand or no operand, filtering is performed based on the RBA or LRSN format of the partition. If partitioned objects have partitions in different formats, PARTLEVEL must specify a non-zero operand or no operand to use BASIC or EXTENDED.

EXTENDED
Specifies that LISTDEF is to perform a final filtering of the INCLUDE or EXCLUDE clause contents based on the extended format with 10-byte RBA or LRSN values. This operation is performed last, after LISTDEF processes all other keywords on the INCLUDE or EXCLUDE clause.

YES
Specifies that only table spaces and index spaces that are in extended format with 10-byte RBA or LRSN values are to be returned in the INCLUDE or EXCLUDE clause. This option is the same as BASIC NO.

NO Specifies that only table spaces and index spaces that are not in extended format with 10-byte RBA or LRSN values format are to be returned in the INCLUDE or EXCLUDE clause. This option is the same as BASIC YES.

The EXTENDED keyword does not have a default value. If the RBA or LRSN format is not a factor, omit the BASIC and EXTENDED keywords.

If the clause also includes the PARTLEVEL keyword with either a non-zero operand or no operand, filtering is performed based on the RBA or LRSN format of the partition. If partitioned objects have partitions in different formats, PARTLEVEL must specify a non-zero operand or no operand to use BASIC or EXTENDED.

Concurrency and compatibility for LISTDEF

The LISTDEF utility has certain concurrency and compatibility characteristics associated with it.

LISTDEF is a control statement that is used to set up an environment for another utility to follow. The LISTDEF list is stored until it is referenced by a specific utility. When referenced by an utility, the list expands. At that time, the concurrency and compatibility restrictions of that utility apply, with the additional restriction that the catalog tables that are necessary to expand the list must be available for read-only access.

List processing limitations

Although DB2 does not limit the number of objects that a list can contain, be aware that if your list is too large, the utility might fail with an error or abend in either DB2 or another program. These errors or abends can be caused by storage limitations, limitations of the operating system, or other restrictions imposed by either DB2 or non-DB2 programs. Whether such a failure occurs depends on many factors including, but not limited to the following items:

- The amount of available storage in both the utility batch and DBM1 address spaces
- The utility that is running.
- The type and number of other utilities that are running at the same time.
- The specific combination of keywords and operands of all the utilities that are running

Recommendation: If you receive a failure that you suspect is caused by running a utility on a list that is too large, divide your list into smaller lists and run the utility or utilities in separate job steps on the smaller lists until they run successfully.

Creating the LISTDEF control statement

The LISTDEF control statement defines a list of objects and assigns a name to the list.

Procedure

To create a LISTDEF control statement, include the following elements in the control statement:

- The name of the list.
- An INCLUDE clause, optionally followed by additional INCLUDE or EXCLUDE clauses to either include or exclude objects from the list.

Related concepts:

"How to include objects in a list"

Related reference:

"Syntax and options of the LISTDEF control statement" on page 221

How to include objects in a list

You can use the LISTDEF control statement options to specify which objects to include in the list. The INCLUDE clause adds objects to the list. The EXCLUDE clause removes objects from the list.

You must first specify an INCLUDE clause. You can then specify subsequent INCLUDE or EXCLUDE clauses in any order to add to or delete objects from the existing list.

DB2 constructs the list, one clause at a time, by adding objects to or removing objects from the list. If an EXCLUDE clause attempts to remove an object that is not yet in the list, DB2 ignores the EXCLUDE clause of that object and proceeds to the next INCLUDE or EXCLUDE clause. Be aware that a subsequent INCLUDE can return a previously excluded object to the list.

You must specify either INCLUDE or EXCLUDE. No default specification exists.

Specifying objects to include or exclude

Each INCLUDE or EXCLUDE clause identifies specific objects to add to or remove from the list.

You must include the following elements in each INCLUDE or EXCLUDE clause:

- The object that is to be used in the initial catalog lookup for each INCLUDE or EXCLUDE clause. The search for objects can begin with databases, table spaces, index spaces, tables, indexes, or other lists. You can explicitly specify the names of these objects or, with the exception of other lists, use a pattern matching expression. The resulting list contains only table spaces, only index spaces, or both.
- The type of objects that the list contains, either TABLESPACES or INDEXSPACES. You must explicitly specify the list type only when you specify a database as the initial object by using the keyword DATABASE. Otherwise, LISTDEF uses the default list type values shown in the following table. These values depend on the type of object that you specified for the INCLUDE or EXCLUDE clause.

Table 31. Default list type values that LISTDEF uses.

Specified object	Default list type value
TABLESPACE	TABLESPACES
TABLE	TABLESPACES
INDEXSPACE	INDEXSPACES
INDEX	INDEXSPACES
LIST	Existing type value of the list

For example, the following INCLUDE clause specifies that table space DBLT0301.TLLT031A is to be added to the LIST:

```
INCLUDE TABLESPACE DBLT0301.TLLT031A
```

In the preceding example, table space DBLT0301.TLLT031A is specified as the object that LISTDEF is to use for the initial catalog lookup. By default, the list type value for a TABLESPACE object is TABLESPACES. Therefore, the list includes only table space DBLT0301.TLLT031A.

The following example INCLUDE clause is similar to the preceding example, except that it includes the INDEXSPACES keyword:

```
INCLUDE INDEXSPACES TABLESPACE DBLT0301.TLLT031A
```

In this example, the clause specifies that all index spaces over all tables in table space DBLT0301.TLLT031A are to be added to the list.

Optionally, you can add related objects to the list by specifying keywords that indicate a relationship, such as referentially related objects or auxiliary related objects. Valid specifications include the following keywords:

- BASE (non-LOB and non-XML objects)
- LOB (LOB objects)
- XML (XML objects)
- ALL (BASE, LOB, and XML objects)
- TABLESPACES (related table spaces)

- INDEXSPACES (related index spaces)
- RI (related by referential constraints, including informational referential constraints)

The preceding keywords perform two functions: they determine which objects are related, and they then filter the contents of the list. The behavior of these keywords varies depending on the type of object that you specify. For example, if your initial object is a LOB object, the LOB keyword is ignored. If, however, the initial object is not a LOB object, the LOB keyword determines which LOB objects are related, and DB2 excludes non-LOB objects from the list.

DB2 processes each INCLUDE and EXCLUDE clause in the following order:

1. Perform the initial search for the object that is based on the specified pattern-matching expression, including PARTLEVEL specification, if specified. If an object is stopped, DB2 returns an error, even if the object is later excluded.
2. Add or remove related objects and filter the list elements based on the specified list type, either TABLESPACES or INDEXSPACES (COPY YES or COPY NO).
3. Add or remove related objects depending on the presence or absence of the RI, BASE, LOB, XML, and ALL keywords.

For example, to generate a list of all table spaces in the ACCOUNT database but exclude all LOB table spaces, you can specify the following LISTDEF statement:

```
LISTDEF ACCNT INCLUDE TABLESPACES DATABASE ACCOUNT BASE
```

In the preceding example, the name of the list is ACCNT. The TABLESPACES keyword indicates that the list is to include table spaces that are associated with the specified object. In this case, the table spaces to be included are those table spaces in database ACCOUNT. Finally, the BASE keyword limits the objects to only base table spaces.

If you want a list of only LOB index spaces in the ACCOUNT database, you can specify the following LISTDEF statement:

```
LISTDEF ACLOBIX INCLUDE INDEXSPACES DATABASE ACCOUNT LOB
```

In the preceding example, the INDEXSPACES and LOB keywords indicate that the INCLUDE clause is to add only LOB index spaces to the ACLOBIX list.

Restriction: Utilities do not support SYSUTILX-related objects inside a LISTDEF specification. You cannot specify the following objects in a LISTDEF:

- TABLESPACE DSNDB01.SYSUTILX
- TABLE SYSIBM.SYSUTILX
- TABLE SYSIBM.SYSUTIL
- INDEXSPACE DSNDB01.DSNLUX01
- INDEXSPACE DSNDB01.DSNLUX02
- INDEX SYSIBM.DSNLUX01
- INDEX SYSIBM.DSNLUX02

Using pattern matching expressions

You can use four special pattern-matching characters (%, *, _,?) to define generic object names in a LISTDEF statement. These characters are similar to those characters that are used in the SQL LIKE predicate. Utilities that reference a list access the DB2 catalog at execution time and dynamically expand each generic

object name into an equivalent enumerated list. A utility processes this enumerated list either sequentially or in parallel, depending on the utility function and the parameters that you specify.

Restrictions: DB2 does not support all-inclusive lists (such as `DATABASE *` or `TABLESPACE *.*`).

Pattern-matching of DB2 catalog and directory objects (DSNDB06 and DSNDB01) is not supported. Catalog and directory objects must be included in a LISTDEF by their full table space or index space name. Even if catalog and directory objects match a LISTDEF pattern matching expression, they are not included in the list. To process those objects, you must use syntax from releases prior to Version 7.

Specify pattern-matching object names by using the pattern-matching characters that are shown in the following table. This table lists the pattern-matching character, the equivalent SQL symbol, and any additional information.

Table 32. LISTDEF pattern-matching characters

LISTDEF pattern-matching character	Equivalent symbol used in SQL LIKE predicates	Usage notes
Percent sign (%)	Percent sign (%)	Performs the same function.
Question mark (?)	Underscore (_)	Use the question mark (?) instead of underscore (_) as a pattern-matching character in table and index names. The underscore character (_) in table and index names represents a single occurrence of itself.
Asterisk (*)	Percent sign (%)	Performs the same function.
Underscore (_)	Underscore (_)	Use the underscore (_) as an alternative to the question mark (?) for database, table space, and index space names.

Including catalog and directory objects

If you specify DB2 directory objects (DSNDB01) and DB2 catalog objects (DSNDB06) in object lists, you must specify the fully qualified table space or index space names for those objects. Pattern-matching is not supported for catalog or directory objects. DB2 issues error messages for any catalog or directory objects that are invalid for a utility.

Although DB2 catalog and directory objects can appear in LISTDEF lists, these objects might be invalid for a utility and result in an error message.

The following valid INCLUDE clauses contain catalog and directory objects:

- `INCLUDE TABLESPACE DSNDB06.SYSDDF`
- `INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSDDF`
- `INCLUDE INDEXSPACE DSNDB06.DSNDXX01`
- `INCLUDE INDEXSPACES INDEXSPACE DSNDB06.DSNDXX01`

Restriction: If you specify a catalog or directory object in a LISTDEF control statement, you cannot specify the following keywords:

- DATABASE
- TABLE
- INDEX
- BASE
- LOB
- ALL
- Databases DSNDB01, DSNDB06, and DSNDB07
- Table or indexes with a creator id of SYSIBM

These keywords require DB2 to access the catalog, which can cause problems when you specify a catalog or directory object.

All LISTDEF lists automatically exclude work file databases, which consist of DSNDB07 objects and user-defined work file objects, because DB2 utilities do not process these objects.

Previewing the contents of a list

You can preview the objects that are to be included in a list by using the PREVIEW function.

About this task

When you run a utility using the PREVIEW function, DB2 expands any LISTDEF control statements into the equivalent enumerated list, prints it to SYSPRINT, and stops execution.

Procedure

To preview the objects that are included in the list:

- Specify PREVIEW as a JCL parameter.
- Specify PREVIEW on the OPTIONS PREVIEW control statement.

Related concepts:

"Using the OPTIONS utility with LISTDEF" on page 239

Related reference:

Chapter 24, "OPTIONS," on page 407

Creating LISTDEF libraries

When DB2 encounters a reference to a list, DB2 first searches SYSIN. If DB2 does not find the definition of the referenced list, DB2 searches the specified LISTDEF library.

Procedure

To create a library of LISTDEF control statements:

Use a DD statement to name LISTDEF data sets.
For example, assume that data sets ADMF001.DB.LIST1 and ADMF001.DB.LIST2 each contain several LISTDEF statements. For any utility jobs that reference these LISTDEF statements, you can include the following DD statement in the JCL:

```
//LISTDSN  DD DSN=ADMF001.DB.LIST1,DISP=SHR
//         DD DSN=ADMF001.DB.LIST2,DISP=SHR
```

This DD statement defines a LISTDEF library. The statement gives a name (LISTDSN) to a group of data sets that contain LISTDEF statements, in this case ADMF001.DB.LIST1 and ADMF001.DB.LIST2. Defining such a library enables you to subsequently refer to the LISTDEF statements in that library by using the OPTIONS LISTDEFDD control statement.
Any data sets that are identified as part of a LISTDEF library must contain only LISTDEF statements.
In the utility job that references those LISTDEF statements, include an OPTIONS statement before the utility statement. In the OPTIONS statement, specify the DD name of the LISTDEF library as LISTDEFDD *ddname*.
DB2 uses this LISTDEF library for any subsequent utility control statements, until either the end of input or until you specify another OPTIONS LISTDEFDD *ddname*. The default DD name for the LISTDEF definition library is SYSLISTD.

Referencing LISTDEF lists in other utility jobs

You can use a list of objects that was defined with a LISTDEF control statement as a target object for another utility.

Procedure

To reference LISTDEF lists in other utility jobs:

1. Specify LISTDEF control statements to define the lists of objects. You can specify these LISTDEF statements in one of the following places:
   - In the SYSIN DD statement before the utility control statement that references it

     Example:

     ```
     //SYSIN    DD *
         LISTDEF MYLIST INCLUDE TABLESPACES DATABASE PAYROLL
                        INCLUDE INDEXSPACES DATABASE PAYROLL
     ```

   - In one or more LISTDEF library data sets

     Example:

     ```
     //*-------------------------------------------------------
     //* Create an input data set.
     //*-------------------------------------------------------
     //LOAD1    EXEC PGM=IEBGENER
     //SYSPRINT DD DUMMY
     //SYSIN    DD DUMMY
     //SYSUT2   DD DSN=JULTU103.TCASE.DATA2,
     //         DISP=(NEW,CATLG,CATLG),
     //         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND),
     //         DCB=(RECFM=FB,LRECL=80,BLKSIZE=2400)
     //SYSUT1   DD *
       LISTDEF NAME1 INCLUDE TABLESPACE DBLT0301.TLLT031A
                     INCLUDE TABLESPACE DBLT0301.TSLT031B
     ```

   Any LISTDEF statement that is defined within the SYSIN DD statement overrides another LISTDEF definition of the same name in a LISTDEF library data set.
2. If you want to reference a list that is defined in a LISTDEF library data set, use the OPTIONS utility. In the SYSIN DD statement before the utility control statement that references the list, specify OPTIONS LISTDEFDD with the name of the LISTDEF library.

   Example:

```
//*****************************************************
//* QUIESCE LISTDEF DD LILSTDEF data sets
//*****************************************************
//STEP1    EXEC DSNUPROC,UID='JULTU103.QUIESC2',
//            UTPROC='',SYSTEM='SSTR'
//LISTLIB  DD DSN=JULTU103.TCASE.DATA2,DISP=SHR
//SYSIN    DD *
    OPTIONS LISTDEFDD LISTLIB
```

3. In the utility control statement, specify the LIST keyword and the list name.

   For example, you can use the QUIESCE utility to quiesce all objects in a list by specifying the following control statement:

   ```
   QUIESCE LIST list-name
   ```

   Some utilities such as COPY and RECOVER, can process a LIST without a specified object type. Object types are determined from the list contents. Other utilities, such as REPORT, RUNSTATS, and REORG INDEX, must know the object type that is to be processed before processing can begin. These utilities require that you specify an object type in addition to the LIST keyword (for example: REPORT RECOVERY TABLESPACE LIST, RUNSTATS INDEX LIST, and REORG INDEX LIST). See the syntax diagrams for an individual utility for details.

Results

In general, utilities process the objects in the list in the order in which they are specified. However, some utilities alter the list order for optimal processing. The following table shows the utilities that support the LIST keyword and how each utility processes the list.

Utility	Order of list processing
CHECK INDEX	Items are grouped by related table space. All index spaces that are related to a particular table space are processed at one time, regardless of list order.
COPY	Items are processed in the specified order on a single call to COPY. The PARALLEL keyword is supported for a list, but if used, the order of processing is determined by DB2.
COPYTOCOPY	Items are processed in the specified order on a single call to COPYTOCOPY.
MERGECOPY	Items are processed in the specified order.
MODIFY RECOVERY	Items are processed in the specified order.
MODIFY STATISTICS	Items are processed in the specified order.
QUIESCE	All items are processed in the specified order on a single call to QUIESCE.
REBUILD	Items are grouped by related table space. All index spaces that are related to a particular table space are processed at one time, regardless of list order.
RECOVER	Items are processed in the specified order on a single call to RECOVER.
REORG	Items are processed in the specified order with one exception. Items at the partition level are grouped by table space when the first partition of a particular table space is encountered. Those partitions are processed on a single call to REORG.
REPORT	Items are processed in the specified order.

Utility	Order of list processing
RUNSTATS INDEX	Items are grouped by related table space. All index spaces that are related to a particular table space are processed at one time, regardless of list order.
RUNSTATS TABLESPACE	Items are processed in the specified order.
UNLOAD	Items at the partition level are grouped by table space. All specified partitions of a particular table space are processed at one time, regardless of list order.

Related tasks:

"Creating LISTDEF libraries" on page 236

Related reference:

"Syntax and options of the LISTDEF control statement" on page 221

"Sample LISTDEF control statements" on page 240

"Syntax and options of the OPTIONS control statement" on page 407

Using the TEMPLATE utility with LISTDEF

Together, the LISTDEF and TEMPLATE utilities enable faster development of utility job streams, and require fewer modifications when the underlying list of database objects change.

Many utilities require output data sets. In those cases, you should use the TEMPLATE control statement to specify the naming convention and, optionally, the allocation parameters for each type of output data set. Templates, like lists, can be reused if the naming convention is robust enough to prevent duplicate data set names from being allocated.

In some cases you can use traditional JCL DD statements with LISTDEF lists, but this method is usually not practical unless you are processing small lists one object at a time.

Related reference:

Chapter 35, "TEMPLATE," on page 789

Using the OPTIONS utility with LISTDEF

You can use the OPTIONS utility with LISTDEF.

Use the following three functions of the OPTIONS utility in conjunction with the LISTDEF utility when needed:

OPTIONS PREVIEW
Enables you to preview the list contents before actual processing.

OPTIONS ITEMERROR
Enables you to alter the handling of errors that might occur during list processing.

OPTIONS LISTDEFDD
Enables you to identify a LISTDEF library. The default value is LISTDEFDD.

Related tasks:

"Creating LISTDEF libraries" on page 236

Termination or restart of LISTDEF

You can terminate and restart the LISTDEF utility.

You can terminate a LISTDEF utility job by using the TERM UTILITY command if you submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart a LISTDEF utility job, but it starts from the beginning again. Use caution when changing LISTDEF lists prior to a restart. When DB2 restarts list processing, it uses a saved copy of the list. Modifying the LISTDEF list that is referred to by the stopped utility has no effect. Only control statements that follow the stopped utility are affected.

Related tasks:

"Restarting an online utility" on page 52

Sample LISTDEF control statements

Use the sample control statements as models for developing your own LISTDEF control statements.

Example 1: Defining a list of objects

The following control statement defines a list that includes the following objects:

- Table space DBLT0301.TLLT031A
- Index space DBLT0301.IXlT031A
- Table space DBLT0301.IPLT031C
- Table space that contains ADMF001.TBLT032A_1

The name of the list is NAME1. This list can be referenced by any subsequent utility statements.

```
LISTDEF NAME1 INCLUDE TABLESPACE DBLT0301.TLLT031A
              INCLUDE INDEXSPACE DBLT0301.IXLT031A
              INCLUDE TABLESPACE DBLT0301.TPLT031C
              INCLUDE TABLESPACES TABLE  ADMF001.TBLT032A_1
```

Example 2: Defining a list of all objects in a database

The following control statement defines a list (EXAMPLE2) that includes all table spaces and all index spaces in the PAYROLL database.

```
LISTDEF EXAMPLE2 INCLUDE TABLESPACES DATABASE PAYROLL
                 INCLUDE INDEXSPACES DATABASE PAYROLL
```

Example 3: Defining a list by using pattern-matching characters

The following control statement defines a list (PAYROLL) that includes the following objects:

- All table spaces in the PAYROLL database, except for any table spaces whose names begin with TEMP.
- All index spaces in the PAYROLL database that end with IX, except for those index spaces that begin with TMPIX.

The subsequent COPY utility control statement processes this list.

```
LISTDEF PAYROLL INCLUDE TABLESPACE PAYROLL.*
                EXCLUDE TABLESPACE PAYROLL.TEMP*
                INCLUDE INDEXSPACE PAYROLL.*IX
                EXCLUDE INDEXSPACE PAYROLL.TMPIX*
COPY LIST PAYROLL ...
```

Example 4: Defining a list of partitions and nonpartitioned table spaces

The following LISTDEF statement defines a list that includes one entry for each partition of the qualifying partitioned table spaces and one entry for each qualifying nonpartitioned table space. The list is named EXAMPLE4. The table spaces must satisfy the PAY*.* name pattern.

```
LISTDEF EXAMPLE4 INCLUDE TABLESPACE PAY*.* PARTLEVEL
```

Assume that three table spaces qualify. Of these table spaces, two are partitioned table spaces (PAY2.DEPTA and PAY2.DEPTF) that each have three partitions and one is a nonpartitioned table space (PAY1.COMP). In this case, the EXAMPLE4 list includes the following items:

- PAY2.DEPTA partition 1
- PAY2.DEPTA partition 2
- PAY2.DEPTA partition 3
- PAY2.DEPTF partition 1
- PAY2.DEPTF partition 2
- PAY2.DEPTF partition 3
- PAY1.COMP

If you specified PARTLEVEL(2) instead of PARTLEVEL, the EXAMPLE4 list includes the following items:

- PAY2.DEPTA partition 2
- PAY2.DEPTF partition 2
- PAY1.COMP

If you specified PARTLEVEL(0) instead of PARTLEVEL, the EXAMPLE4 list includes only PAY1.COMP.

Example 5: Defining a list of COPY YES indexes

The following control statement defines a list (EXAMPLE5) that includes related index spaces from the referenced list (EXAMPLE4) that were defined or altered to COPY YES.

```
LISTDEF EXAMPLE5 INCLUDE LIST EXAMPLE4 INDEXSPACES COPY YES
```

Example 6: Defining a list that includes all table space partitions except for one

The following control statement defines a list (EXAMPLE6) that includes all partitions of table space X, except for partition 12. The INCLUDE clause adds an entry for each partition, and the EXCLUDE clause removes the entry for partition 12.

```
LISTDEF EXAMPLE6 INCLUDE TABLESPACE X PARTLEVEL
                 EXCLUDE TABLESPACE X PARTLEVEL(12)
```

If the PARTLEVEL keyword is not specified in both clauses, as in the following two sample statements, the INCLUDE and EXCLUDE items do not intersect. For example, in the following statement, table space X is included in the list in its entirety, not at the partition level. Therefore, partition 12 cannot be excluded.

```
LISTDEF EXAMPLE6 INCLUDE TABLESPACE X
                 EXCLUDE TABLESPACE X PARTLEVEL(12)
```

In the following sample statement, the list includes only partition 12 of table space X, so table space X in its entirety cannot be excluded.

```
LISTDEF EXAMPLE6 INCLUDE TABLESPACE X PARTLEVEL(12)
                 EXCLUDE TABLESPACE X
```

Example 7: Defining a LISTDEF library and referencing a list in a QUIESCE job

In this example, the first two LISTDEF control statements define the NAME1 and NAME2 lists. The NAME1 list is stored in a sequential data set (JULTU103.TCASE.DATA2). The NAME2 list is stored in a member of a partitioned data set (JULTU103.TCASE.DATA3(MEM1)). These output data sets are identified by the SYSUT2 DD statements (in the JCL for the CREATE1 and CREATE2 jobs).

The LISTLIB DD statement (in the JCL for the QUIESCE job) defines a LISTDEF library. When you define a LISTDEF library, you give a name to a group of data sets that contain LISTDEF statements. In this case, the library is to include the following data sets:

- The sequential data set JULTU103.TCASE.DATA2 (which includes the NAME1 list)
- The MEM1 member of the partitioned data set JULTU103.TCASE.DATA3 (which includes the NAME2 list).

When you define such a library, you can later reference a group of LISTDEF statements with a single reference.

The OPTIONS utility statement in this example specifies that the library that is identified by the LISTLIB DD statement is to be used as the default LISTDEF definition library. This declaration means that for any referenced lists, DB2 is to first search SYSIN for the list definition. If DB2 does not find the list definition in SYSIN, it is to search any data sets that are included in the LISTLIB LISTDEF library.

The last LISTDEF statement defines the NAME3 list. This list includes all objects in the NAME1 and NAME2 lists, except for three table spaces (TSLT032B, TSLT031B, TSLT032C). Because the NAME1 and NAME2 lists are not included in SYSIN, DB2 searches the default LISTDEF library (LISTLIB) to find them.

Finally, the QUIESCE utility control statement specifies this list of objects (NAME3) for which DB2 is to establish a quiesce point.

```
//CREATE1  JOB 'USER=NAME',CLASS=A,...
//*-------------------------------------------------------
//* Create an input data set.
//*-------------------------------------------------------
//LOAD1    EXEC PGM=IEBGENER
//SYSPRINT DD DUMMY
//SYSIN    DD DUMMY
//SYSUT2   DD DSN=JULTU103.TCASE.DATA2,
//         DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND),
```

```
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=2400)
//SYSUT1   DD *
  LISTDEF NAME1 INCLUDE TABLESPACE DBLT0301.TLLT031A
                INCLUDE TABLESPACE DBLT0301.TSLT031B
/*
//CREATE2  JOB 'USER=NAME',CLASS=A,...
//*-------------------------------------------------------
//* Create an input data set.
//*-------------------------------------------------------
//CRECNTL  EXEC PGM=IEFBR14
//CNTL     DD  DSN=JULTU103.TCASE.DATA3,UNIT=SYSDA,
//             VOL=SER=SCR03,
//             SPACE=(TRK,(2,2,2)),DCB=(DSORG=PO,
//             LRECL=80,RECFM=FB,BLKSIZE=4560),
//             DISP=(NEW,CATLG,CATLG)
/*
//*-------------------------------------------------------
//* Create member of input data set.
//*-------------------------------------------------------
//FILLCNTL EXEC PGM=IEBUPDTE
//SYSPRINT DD  SYSOUT=*
//SYSUT1   DD  DSN=JULTU103.TCASE.DATA3,DISP=OLD
//SYSUT2   DD  DSN=JULTU103.TCASE.DATA3,DISP=OLD
//SYSIN  DD  DATA
./ ADD NAME=MEM1
  LISTDEF NAME2 INCLUDE TABLESPACE DBLT0302.TLLT032A
                INCLUDE TABLESPACE DBLT0302.TSLT032B
                INCLUDE TABLESPACE DBLT0302.TPLT032C
./ ENDUP
/*

//QUIESCE  JOB 'USER=NAME',CLASS=A,...
//*******************************************************
//* QUIESCE LISTDEF DD LILSTDEF data sets
//*******************************************************
//STEP1    EXEC DSNUPROC,UID='JULTU103.QUIESC2',
//            UTPROC='',SYSTEM='SSTR'
//LISTLIB  DD DSN=JULTU103.TCASE.DATA2,DISP=SHR
//         DD DSN=JULTU103.TCASE.DATA3(MEM1),DISP=SHR
//SYSIN    DD *
    OPTIONS LISTDEFDD LISTLIB
    LISTDEF NAME3 INCLUDE LIST NAME1
                  INCLUDE LIST NAME2
                  EXCLUDE TABLESPACE DBLT0302.TSLT032B
                  EXCLUDE TABLESPACE DBLT0301.TSLT031B
                  EXCLUDE TABLESPACE DBLT0302.TPLT032C
    QUIESCE LIST NAME3
/*
```

Figure 26. Example of building a LISTDEF library and then running the QUIESCE utility

Example 8: Defining a list that includes related objects

The following LISTDEF control statement defines a list (EXAMPLE8) that includes table space DBLT0101.TPLT011C and all objects that are referentially related to it. Only base table spaces are included in the list. The subsequent RECOVER utility control statement specifies that all objects in the EXAMPLE8 list are to be recovered.

```
//STEP2    EXEC DSNUPROC,UID='JULTU101.RECOVE5',
//            UTPROC='',SYSTEM='SSTR'
//SYSIN    DD *
    LISTDEF EXAMPLE8 INCLUDE TABLESPACE DBLT0101.TPLT011C RI BASE
    RECOVER LIST EXAMPLE8
/*
```

Example 9: Defining a list of cloned data

The following control statement indicates that the INCLUDE expression is to return only the names of the following objects:

- Clone tables
- Table spaces that contain clone tables
- Indexes on clone tables
- Index spaces that contain indexes on clone tables

```
LISTDEF REORG_TBSP INCLUDE TABLESPACE DB42240*.T*
                            CLONED YES
                     EXCLUDE TABLESPACE DB42240*.TL4224L*
                     EXCLUDE TABLESPACE DB42240*.TL4224B*
                     EXCLUDE TABLESPACE DB42240*.TL4224C*
                     EXCLUDE TABLESPACE DB42240*.TL4224D*
                     EXCLUDE TABLESPACE DB42240*.TL4224E*
                     EXCLUDE TABLESPACE DB42240*.TL4224F*
                     EXCLUDE TABLESPACE DB422401.TSHR5702
```

Example 10: Defining a list that includes archive objects

The following LISTDEF statement defines a list with the name LISTALL that includes all related table spaces, including related archive table spaces.

```
LISTDEF  LISTALL
   INCLUDE TABLESPACES TABLESPACE DB516A01.TU516A01 RI ALL
   INCLUDE TABLESPACES TABLESPACE DB516A01.TU516A01 RI ALL ARCHIVE
```

The first INCLUDE clause specifies that all base, LOB, and XML table spaces that are referentially related to the table space DB516A01.TU516A01 are to be included in the list. The second INCLUDE clause specifies that all archive table spaces that are related to table space DB516A01.TU516A01 are to be included in the list.

Chapter 20. LOAD

Use the LOAD online utility to load one or more tables of a table space. The LOAD utility loads records into the tables and builds or extends any indexes that are defined on them.

If the table space already contains data, you can choose whether you want to add the new data to the existing data or replace the existing data.

The loaded data is processed by any edit or validation routine that is associated with the table, and any field procedure that is associated with any column of the table. The LOAD utility ignores and does not enforce informational referential constraints.

To avoid the cost of running the RUNSTATS utility afterward, you can also specify the STATISTICS option collect inline statistics when you run the LOAD utility.

Output

LOAD DATA generates one or more of the following forms of output:

- A loaded table space or partition.
- A discard file of rejected records.
- A summary report of errors that were encountered during processing; this report is generated only if you specify ENFORCE CONSTRAINTS or if the LOAD involves unique indexes.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorizations:

- Ownership of the table
- LOAD privilege for the database
- STATS privilege for the database is required if STATISTICS keyword is specified
- DBADM or DBCTRL authority for the database. If the database is implicitly created, these privileges must be on the implicitly created database or on DSNDB04.
- DATAACCESS authority
- SYSCTRL or SYSADM authority

LOAD operates on a table space level, so you must have authority for all tables in the table space when you perform LOAD.

To run LOAD STATISTICS, the privilege set must include STATS authority on the database. To run LOAD STATISTICS REPORT YES, the privilege set must also include the SELECT privilege on the tables required.

If either the FLASHCOPY YES or FLASHCOPY CONSISTENT option is specified, the user ID that invokes the LOAD utility must have the authority to execute the DFSMSdss COPY command.

If you use RACF access control with multilevel security and LOAD is to process a table space that contains a table that has multilevel security with row-level

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granularity, you must be identified to RACF and have an accessible valid security label. You must also meet the following authorization requirements:

- To replace an entire table space with LOAD REPLACE, you must have the write-down privilege unless write-down rules are not in effect.
- You must have the write-down privilege to specify values for the security label columns, unless write-down rules are not in effect. If these rules are in effect and you do not have write-down privilege, DB2 assigns your security label as the value for the security label column for the rows that you are loading.

Restrictions on running LOAD

- LOAD with REPLACE cannot be run on a table space during the period after RECOVER is run to a point in time before materialization of pending definition changes and before REORG is run to complete the point-in-time recovery process.

Execution phases of LOAD

The LOAD utility operates in the following phases:

UTILINIT
Performs initialization.

RELOAD
Loads record types and writes temporary file records for indexes and foreign keys. RELOAD makes one pass through the sequential input data set. Check constraints are checked for each row. Internal commits provide commit points at which to restart in case operation should halt in this phase.

RELOAD creates inline copies if you specified the COPYDDN or RECOVERYDDN keywords.

A subtask is started at the beginning of the RELOAD phase to sort the keys. The sort subtask initializes and waits for the main RELOAD phase to pass its keys to SORT. RELOAD loads the data, extracts the keys, and passes them in memory for sorting. At the end of the RELOAD phase, the last key is passed to SORT, and record sorting completes.

Note that load partition parallelism starts subtasks. PREFORMAT for table spaces occurs at the end of the RELOAD phase.

SORT Sorts temporary file records before creating indexes or validating referential constraints, if indexes or foreign keys exist. The SORT phase is skipped if all the following conditions apply for the data that is processed during the RELOAD phase:
- Each table has no more than one key.
- All keys are the same type (index key only, indexed foreign key, or foreign key only).
- The data that is being loaded or reloaded is in key order (if a key exists). If the key is an index key only and the index is a data-partitioned secondary index, the data is considered to be in order if the data is grouped by partition and ordered within partition by key value. If the key in question is an indexed foreign key and the index is a data-partitioned secondary index, the data is never considered to be in order.
- The data that is being loaded or reloaded is grouped by table, and each input record is loaded into one table only.

SORT passes the sorted keys in memory to the BUILD phase, which builds the indexes.

BUILD
Creates indexes from temporary file records for all indexes that are defined on the loaded tables. Build also detects duplicate keys. PREFORMAT for indexes occurs at the end of the BUILD phase.

SORTBLD
Performs all activities that normally occur in both the SORT and BUILD phases, if you specify a parallel index build.

INDEXVAL
Corrects unique index violations or index evaluation errors from the information in SYSERR, if any exist.

ENFORCE
Checks referential constraints, except informational referential constraints, and corrects violations. Information about violations of referential constraints is stored in SYSERR.

DISCARD
Copies records that cause errors from the input data set to the discard data set.

REPORT
Generates a summary report, if you specified ENFORCE CONSTRAINT or if load index validation is performed. The report is sent to SYSPRINT.

LOGAPPLY
If LOAD SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, log apply applies the updates to the FlashCopy image copy to ensure that all activity is reflected up to the point of consistency.

LOGCSR
If LOAD SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, the LOGCSR phase identifies any uncommitted work to back out from the FlashCopy image copy.

LOGUNDO
If LOAD SHRLEVEL CHANGE FLASHCOPY CONSISTENT is specified, the LOGUNDO phase backs out uncommitted work from the FlashCopy image copy.

UTILTERM
Performs cleanup.

Related concepts:

Multilevel security (Managing Security)

Related tasks:

Loading data with the LOAD utility (DB2 Administration Guide)

Maintaining statistics in the catalog (DB2 Performance)

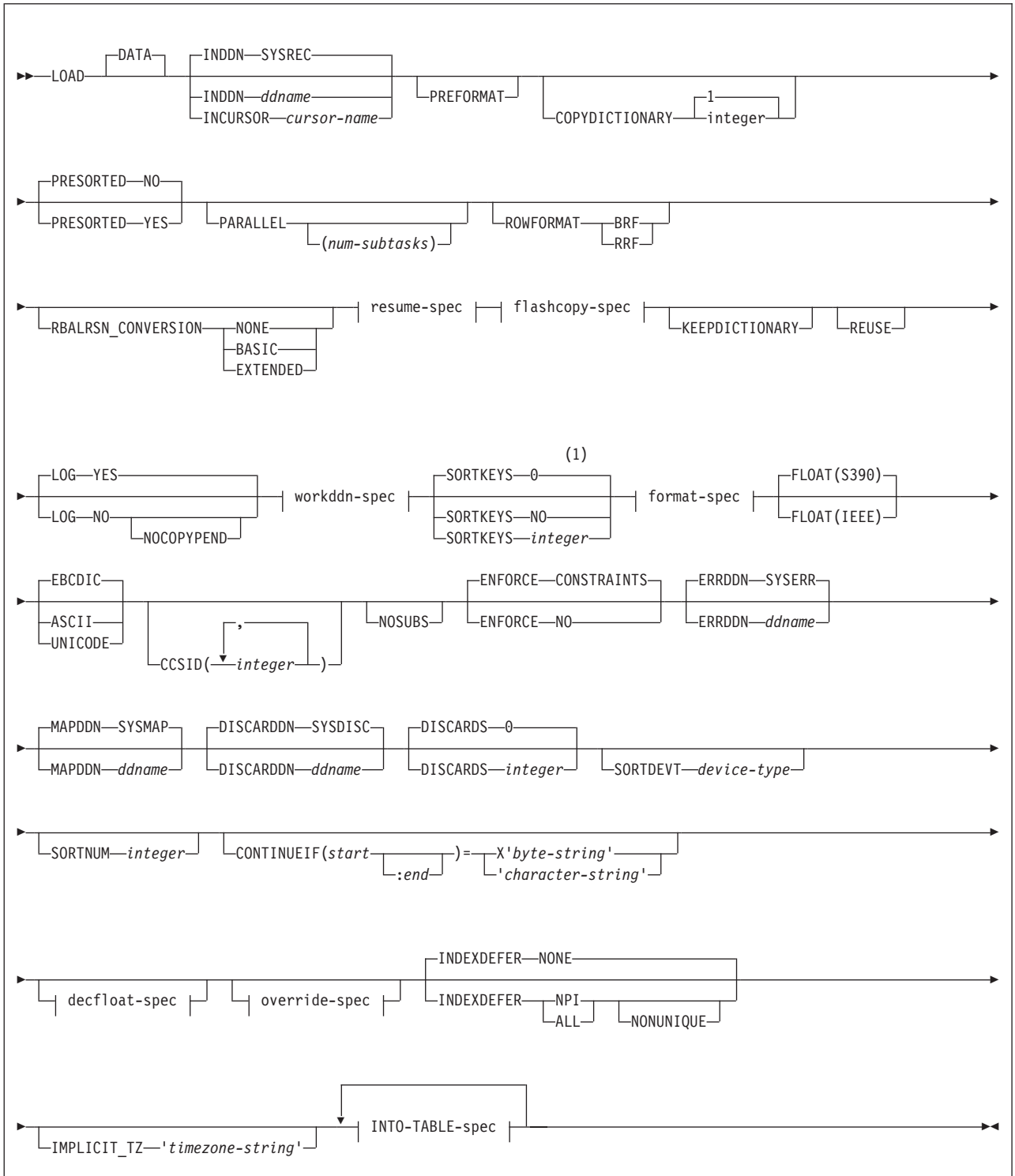
Reducing the cost of collecting statistics (DB2 Performance)

Syntax and options of the LOAD control statement

The LOAD utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

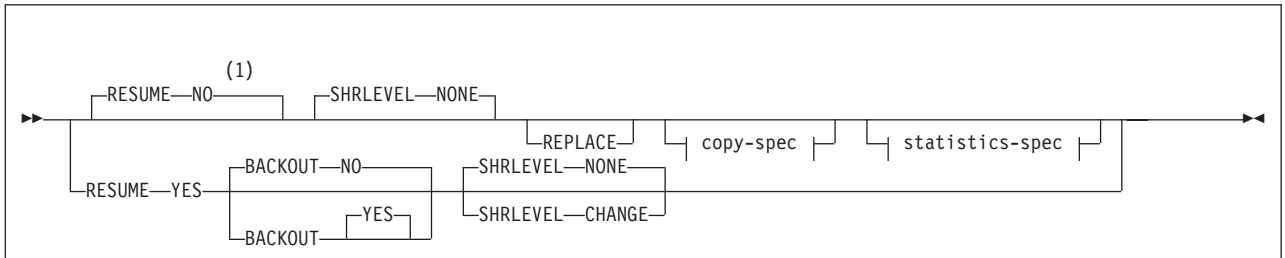
Syntax diagram



Notes:

1 The default is 0 if the input is on tape, a cursor, a PDS member or for SYSREC DD *. For sequential data sets on disk, LOAD computes the default based on the input data set size.

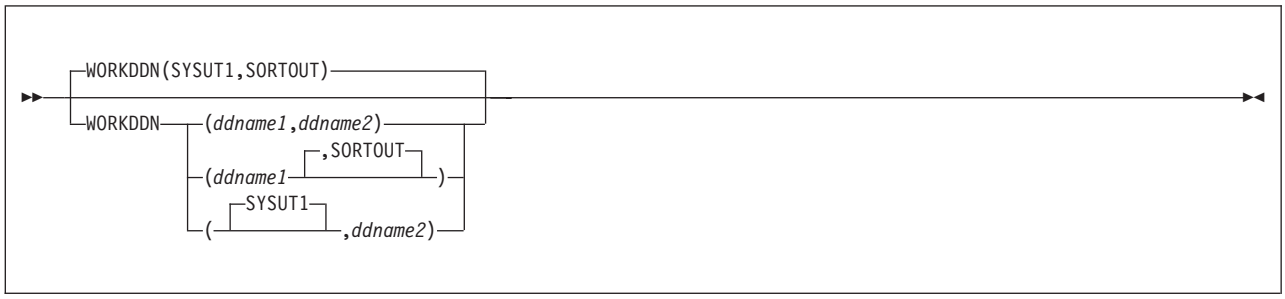
resume-spec:



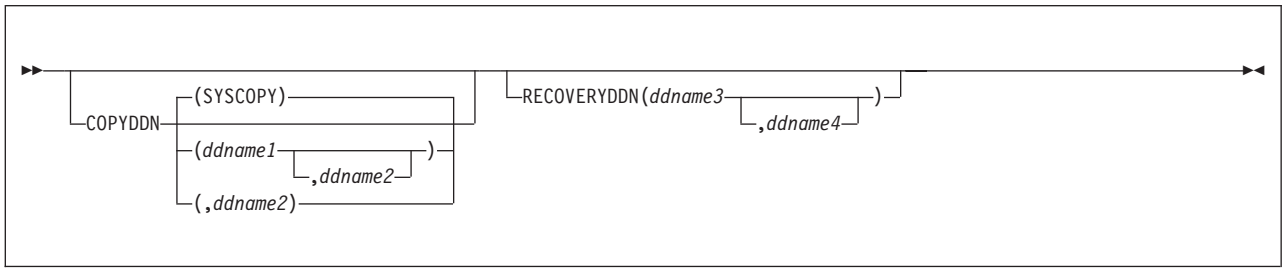
Notes:

1 The value specified in the INTO TABLE for RESUME or REPLACE overrides the default value for LOAD RESUME.

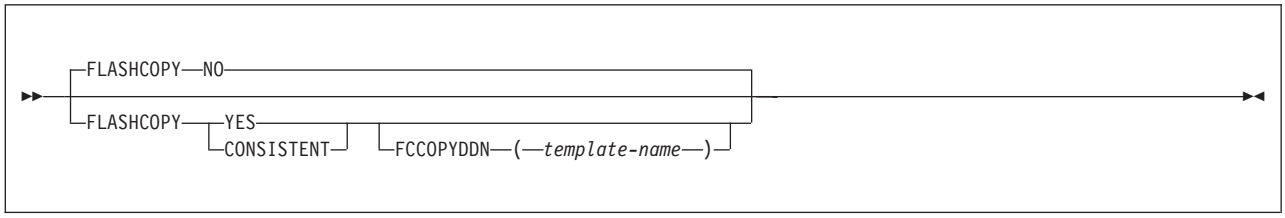
workddn-spec:



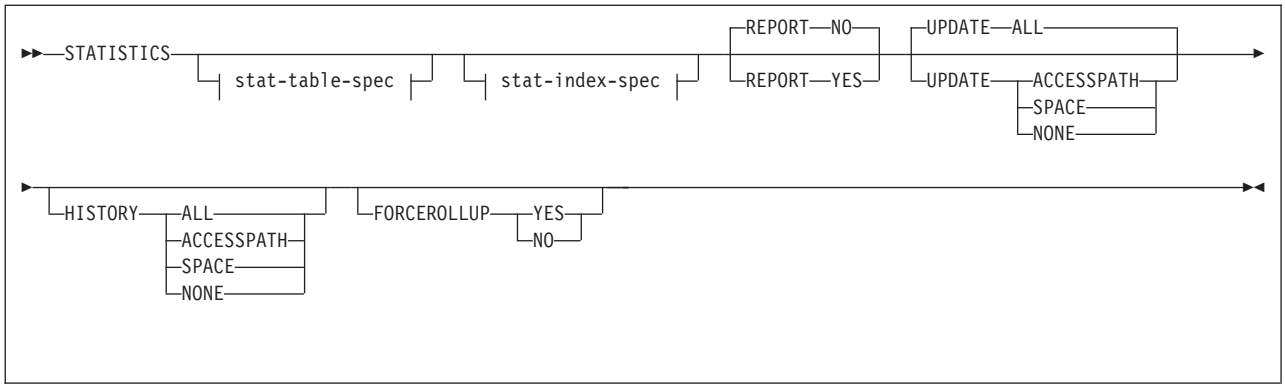
copy-spec:



flashcopy-spec:



statistics-spec:



stat-table-spec

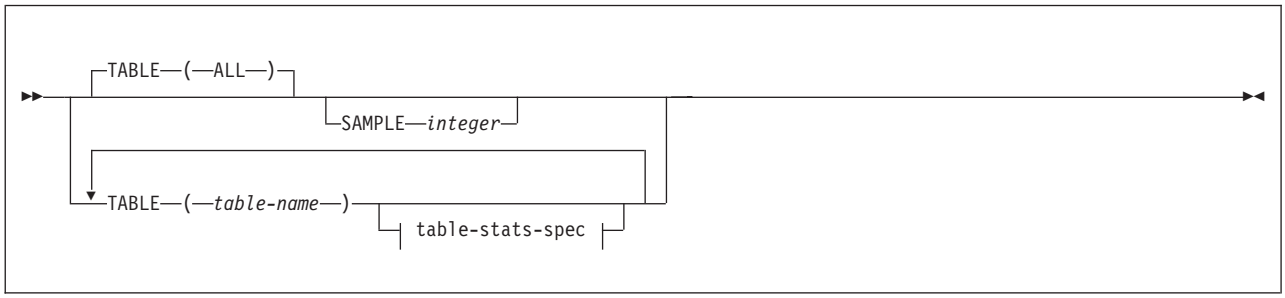
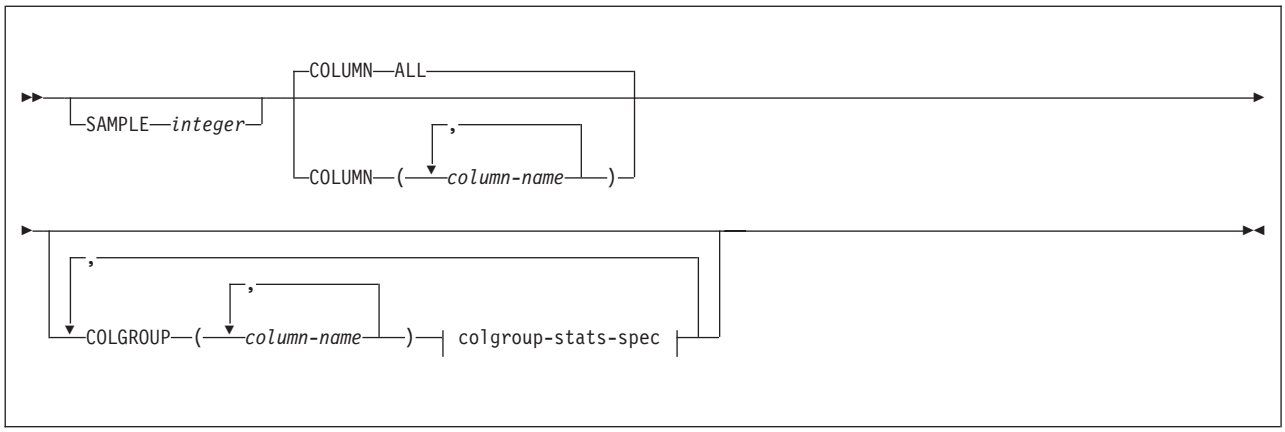
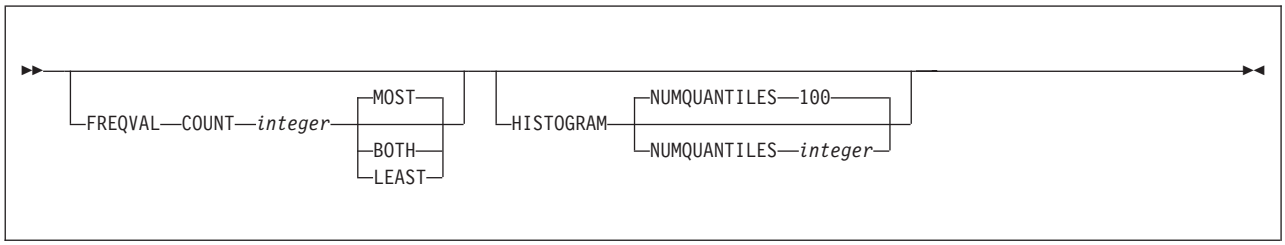


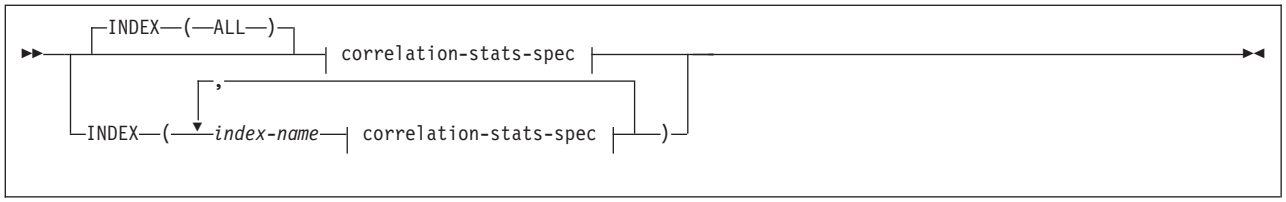
table-stats-spec:



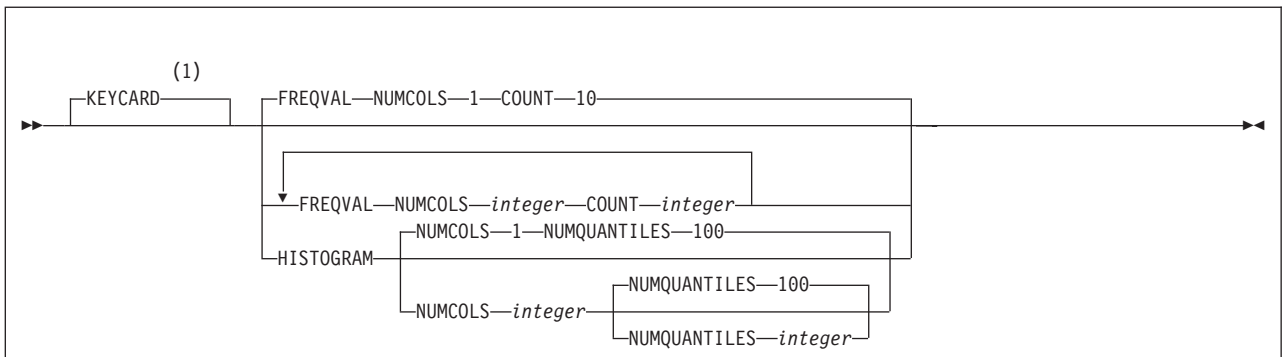
colgroup-stats-spec:



stat-index-spec



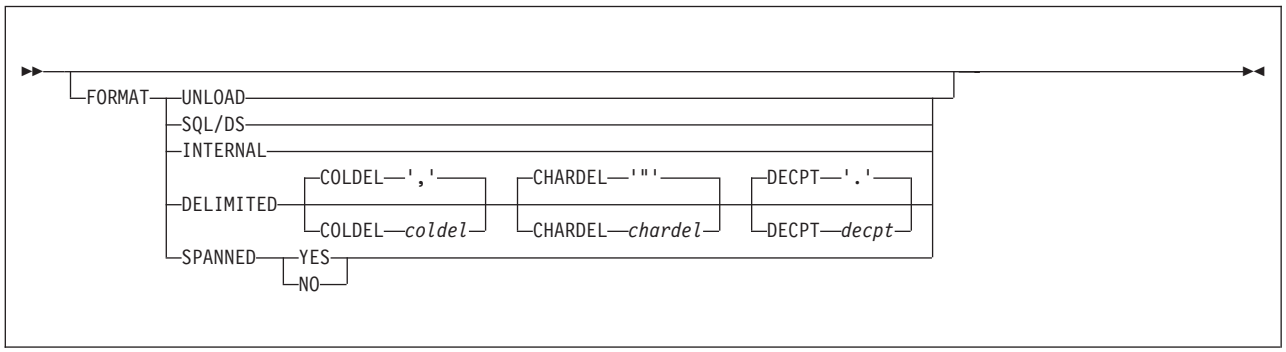
correlation-stats-spec:



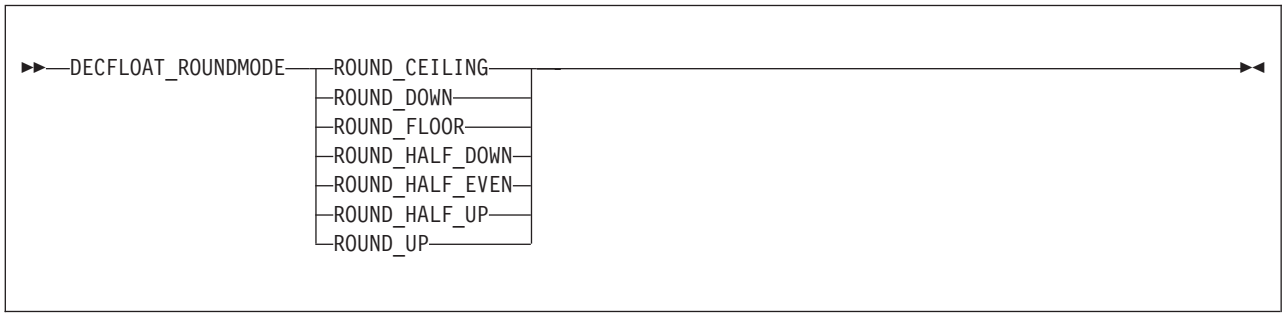
Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the default execution of the inline statistics for indexes and cannot be disabled.

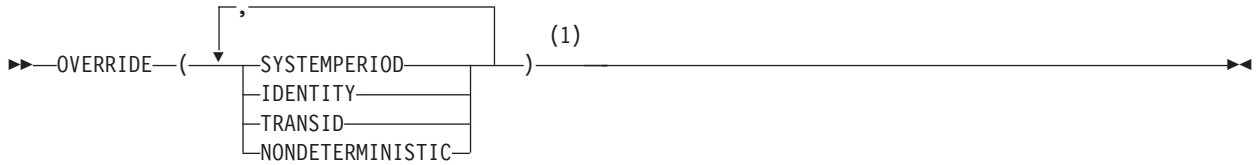
format-spec:



decfloat-spec:



override-spec:



Notes:

1 **Alternate syntax:** The following syntax is still accepted: PERIODOVERRIDE instead of OVERRIDE(SYSTEMPERIOD), TRANSIDOVERRIDE instead of OVERRIDE(TRANSID), IDENTITYOVERRIDE instead of OVERRIDE(IDENTITY). However, the keywords PERIODOVERRIDE, TRANSIDOVERRIDE, and IDENTITYOVERRIDE are deprecated.

INTO-TABLE-spec:

For the syntax diagram and the option descriptions of the into-table specification, see "INTO-TABLE-spec" on page 279.

Option descriptions

DATA
Specifies that data is to be loaded. This keyword is optional and is used for clarity only.

INDDN *ddname*
Specifies the data definition (DD) statement or template that identifies the input data set for the partition. The record format for the input data set must be fixed-length or variable-length. The data set must be readable by the basic sequential access method (BSAM).

If the input file is an HFS or zFS file, use a template with the PATH option.

The *ddname* is the name of the input data set.

The default value is **SYSREC**.

Related information:

"Syntax and options of the TEMPLATE control statement" on page 789

INCURSOR *cursor-name*
Specifies the cursor for the input data set. You must declare the cursor before it is used by the LOAD utility. Use the EXEC SQL utility control statement to define the cursor. You cannot load data into the same table on which you defined the cursor. You cannot load data into a table that is a parent in a RI relationship with the dependent table on which the cursor is defined.

The specified cursor can be used with the DB2 family cross-loader function, which enables you to load data from any DRDA-compliant remote server. For more information about using the cross-loader function, see "Loading data by using the cross-loader function" on page 331.

cursor-name is the cursor name. Cursor names that are specified with the LOAD utility cannot be longer than eight characters.

You cannot use the INCURSOR option with the following options:

- SHRLEVEL CHANGE
- NOSUBS
- FORMAT UNLOAD
- FORMAT SQL/DS
- FORMAT INTERNAL
- CONTINUEIF
- WHEN
- SPANNED YES

In addition, you cannot specify field specifications or use discard processing with the INCURSOR option.

PREFORMAT
Specifies that the remaining pages are preformatted up to the high-allocated RBA in the table space and index spaces that are associated with the table that is specified in *table-name*. The preformatting occurs after the data has been loaded and the indexes are built.

PREFORMAT can operate on an entire table space and its index spaces, or on a partition of a partitioned table space and on the corresponding partitions of partitioned indexes, if any exist. Specifying LOAD PREFORMAT (rather than PART *integer* PREFORMAT) tells LOAD to serialize at the table space level, which can inhibit concurrent processing of separate partitions. If you want to serialize at the partition level, specify PART *integer* PREFORMAT.

The PREFORMAT keyword also applies to LOB table spaces and auxiliary indexes that are associated with the base table or partitions that LOAD serialized. XML objects are not preformatted.

COPYDICTIONARY *integer*
Allows the LOAD utility to copy an existing compression dictionary from a partition to other partitions of a partitioned table space. LOAD copies the current compression dictionary from the partition whose partition number is *integer*, and uses that compression dictionary to compress the input data for partitions that are being replaced. The default value of *integer* is 1.

COPYDICTIONARY provides a method for copying a compression dictionary to an empty partition. The partition that is being copied must have a valid compression dictionary.

COPYDICTIONARY causes LOAD to copy the compression dictionary only to partitions that have the COMPRESS YES attribute.

Use of the COPYDICTIONARY keyword has these restrictions:

- COPYDICTIONARY can be used only when the target of the LOAD statement is a partitioned or range-partitioned table space.
- PART *integer* REPLACE must also be specified in the LOAD statement.
- RESUME YES cannot be specified with COPYDICTIONARY.
- KEEPDICTIONARY cannot also be specified in the LOAD statement.

PRESORTED
Specifies whether the input data set has already been sorted in clustering key order. If the input data set is in clustering key order, the LOAD utility can execute the RELOAD and BUILD phases in parallel, and can skip the sorting of the clustering index.

NO Specifies that the input data set has not already been sorted. The LOAD utility must sort the clustering index.

YES

Specifies that the input data set has already been sorted. The LOAD utility does not sort the clustering index, and executes the RELOAD and BUILD phases in parallel.

The following requirements must be satisfied when PRESORTED YES is specified:

- All data sets that are needed for parallel index build need to be available.
- For partitioned table spaces with a clustering partitioned index, the presorted order of the data rows must be:
  1. By partition number
  2. By key ordering of clustering index within each partition
- For partitioned table spaces with a clustering nonpartitioned index, or nonpartitioned table space with a single table, the presorted order of the data rows must be by key ordering of the clustering index.
- For simple and segmented table spaces:
  - The presorted order of the data rows must be by key ordering of the clustering index within the table.
  - The LOAD statement can contain only one INTO TABLE clause.

Restrictions:

- Under the following conditions, LOAD issues a warning message, and continues with processing as if PRESORTED NO were specified:
  - When SHRLEVEL CHANGE is also specified
  - When partition parallelism is used
  - When the target tables have no indexes
  - When SORTKEYS NO is specified
- Only LOAD with REPLACE and with PRESORTED YES can be restarted in the RELOAD phase. If LOAD with RESUME and PRESORTED YES is restarted in the RELOAD phase, utility processing abnormally terminates, and LOAD issues an error message.
- If PRESORTED YES is specified, and LOAD determines that the input data set is not sorted in clustering key order, LOAD tolerates the keys that are not in order. However, for the clustering index, inline statistics are not collected and real-time statistics are invalidated. LOAD issues a warning message.

PARALLEL

For a single input data set, the PARALLEL option specifies the maximum number of subtasks that are to be used in parallel when the utility loads a table space from a single input data set and builds the indexes. By using parallel subtasks, the utility can potentially reduce the elapsed time of the load operation.

For multiple input data sets, where there is one data set for each partition, the PARALLEL option specifies the maximum number of subtasks that are to be used with loading the data partitions, building the indexes, and gathering statistics. This situation applies to partitioned (non-universal) table spaces and range-partitioned universal table spaces. If the PARALLEL keyword is omitted, the load operation uses the optimal number of subtasks with applied constraints.

The specified number of subtasks for PARALLEL always overrides the specification of the PARAMDEG_UTIL subsystem parameter, so PARALLEL can be smaller or larger than the value of PARAMDEG_UTIL.

Recommendation: If you specify the PARALLEL keyword and SHRLEVEL CHANGE, set the LOCKSIZE attribute of the table space to ROW to minimize contention on the parallel subtasks.

Restrictions: The PARALLEL keyword is not valid in the following situations:

- For a single input data set, the LOAD statement includes any of the following options:
  - SPANNED YES
  - INCURSOR
  - PRESORTED
  - FORMAT INTERNAL
  - COLGROUP
- The table space to be loaded is a partition-by-growth table space.
- The table to be loaded has XML columns and is in a simple or segmented table space, and the LOAD statement includes the SHRLEVEL CHANGE option.
- The table to be loaded has LOB or XML columns, and the LOAD statement includes the SHRLEVEL NONE option.

(*num-subtasks*)
Specifies the maximum number of subtasks that are to be processed in parallel. The value must be an integer between 0 and 32767, inclusive.

If you specify SHRLEVEL CHANGE, *num-subtasks* represents the number of subtasks for loading the data and preprocessing the records. If you specify SHRLEVEL NONE, *num-subtasks* represents the number of subtasks for only preprocessing the records.

Recommendation: Specify PARALLEL(0) or PARALLEL.

The LOAD utility calculates an optimal number of subtasks to process in parallel based on memory constraints, virtual storage constraints, and the number of available processors. If 0 or no value is specified for *num-subtasks*, the LOAD utility uses the optimal number of parallel subtasks. If the specified value for *num-subtasks* is greater than the calculated optimal number, LOAD limits the number of parallel subtasks to the optimal number. If the specified value for *num-subtasks* is less than the calculated optimal number, LOAD uses the specified value. If the specified value for *num-subtasks* is greater than 32767, the LOAD statement fails.

If you specify 1 for *num-subtasks*, the LOAD utility loads the data serially, as if PARALLEL was not specified. For a single input data set, parallel index building is still possible with PARALLEL(1). However, if you specify PARALLEL(1) for partition parallelism (multiple input data sets), parallelism is constrained for both loading data and building indexes.

For a single input data set, the default is PARALLEL(1). For partition parallelism, the default is PARALLEL(0).

If you specify the PARALLEL keyword without a value, the default value is PARALLEL(0).

Related information:

"Improving LOAD performance" on page 334

Types of DB2 table spaces (Introduction to DB2 for z/OS)

Specifying the size of locks for a table space (DB2 Performance)

ROWFORMAT

Specifies the output row format in the affected table space or partition. This keyword overrides the existing RRF subsystem parameter setting. This keyword has no effect on LOB, catalog, directory, XML, or universal table spaces participating in a CLONE relationship.

BRF

Specifies that the table space or partition being reorganized or replaced will be converted to or remain in basic row format.

RRF

Specifies that the table space or partition being reorganized or replaced will be converted to or remain in reorder row format.

RBALRSN_CONVERSION

Specifies the RBA or LRSN format of the target object after the completion of the LOAD utility. If the keyword is not specified, the conversion specified in the UTILITY_OBJECT_CONVERSION subsystem parameter is accepted. If you specify RBALRSN_CONVERSION, you must also specify the REPLACE keyword.

NONE

Specifies that no conversion is performed.

The utility fails if RBALRSN_CONVERSION NONE is specified on a table space that is in basic 6-byte format and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

BASIC

Specifies that if an object is found in extended 10-byte format, it is converted to 6-byte basic format.

The utility fails if RBALRSN_CONVERSION BASIC is specified and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

EXTENDED

Specifies that if an object is found in basic 6-byte format, it is converted to 10-byte extended format.

If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to BASIC or EXTENDED, RBALRSN_CONVERSION defaults to the UTILITY_OBJECT_CONVERSION value. If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to NOBASIC, RBALRSN_CONVERSION defaults to EXTENDED.

LOAD REPLACE of a base table space, when converting page format to extended, does not convert versioned XML table spaces that are associated with that base table space.

RESUME

Indicates whether records are to be loaded into an empty or non-empty table space. For nonsegmented table spaces, space is not reused for rows that have been marked as deleted or for rows of dropped tables.

Important: Specifying LOAD RESUME (rather than PART *integer* RESUME) tells LOAD to serialize on the entire table space, which can inhibit concurrent processing of separate partitions. If you want to process other partitions concurrently, specify PART *integer* RESUME.

NO Loads records into an empty table space. If the table space is not empty, and you have not used REPLACE, a message is issued and the utility job step terminates with a job step condition code of 8.

For nonsegmented table spaces that contain deleted rows or rows of dropped tables, using the REPLACE keyword provides increased efficiency.

The **default** value is **NO**, unless you override it with PART *integer* RESUME YES.

YES
Loads records into a non-empty table space. If the table space is empty, a warning message is issued, but the table space is loaded. Loading begins at the current end of data in the table space. Space is not reused for rows that are marked as deleted or for rows of dropped tables.

LOAD RESUME YES SHRLEVEL CHANGE activates the before triggers and after triggers for each row that is loaded.

BACKOUT

YES Specifies that all rows loaded by the current LOAD should be deleted if any input record has violations. The table space is available at the completion of the LOAD. This option does not perform discard processing. If BACKOUT is specified alone, the default value is YES.

BACKOUT or BACKOUT YES is only allowed with SHRLEVEL NONE. BACKOUT or BACKOUT YES is not allowed with INCURSOR.

Keywords associated with discard processing (i.e. DISCARDDN and DISCARDS) are allowed with BACKOUT YES, but no discard processing occurs.

NO Specifies that updates made by LOAD will not be rolled back if an error record is found. This is the default behavior when the BACKOUT keyword is not specified.

SHRLEVEL
Specifies the extent to which applications can concurrently access the table space or partition during the LOAD utility job. The following parameter values are listed in order of increasing extent of allowed concurrent access.

NONE
Specifies that applications have no concurrent access to the table space or partition.

CHANGE
Specifies that applications can concurrently read from and write to the table space or partition into which LOAD is loading data.

A LOAD SHRLEVEL CHANGE job functions like a mass INSERT. Whereas a regular LOAD job drains the entire table space, LOAD SHRLEVEL CHANGE functions like an INSERT statement and uses claims when it accesses an object.

If you specify SHRLEVEL CHANGE, you cannot specify any of the following parameters:

- INCURSOR

- RESUME NO
- REPLACE
- KEEPDICTIONARY
- LOG NO
- ENFORCE NO
- STATISTICS
- COPYDDN
- RECOVERYDDN
- MAPDDN
- PREFORMAT
- REUSE
- PART *integer* REPLACE

If you are loading individual partitions and specify SHRLEVEL CHANGE, RESUME YES must also be specified. You can either specify RESUME YES on the individual PART clauses or inherit it from the main LOAD statement.

LOAD SHRLEVEL CHANGE does not perform the SORT, BUILD, SORTBLD, INDEXVAL, or ENFORCE phases, and the compatibility and concurrency considerations differ.

Normally, a LOAD RESUME YES job loads the records at the end of the already existing records. However, for a LOAD RESUME YES job with the SHRLEVEL CHANGE option, the utility tries to insert the new records in available free space as close to the clustering order as possible. This LOAD job does not create any additional free pages. If you insert many records, these records are likely to be stored out of clustering order. In this case, you should run the REORG TABLESPACE utility after the LOAD utility loads the records.

Recommendation: If the LOAD utility loads many records, run RUNSTATS SHRLEVEL CHANGE UPDATE SPACE and then a conditional REORG.

When an identity column exists in the table that is being loaded, performance can be improved by specifying the CACHE attribute for the identity column.

Lock escalation is disabled on XML table spaces for LOAD SHRLEVEL CHANGE.

Log records that DB2 creates during LOAD SHRLEVEL CHANGE can be used by DB2 DataPropagator, if the tables that are being loaded are defined with DATA CAPTURE CHANGES.

LOAD jobs with the SHRLEVEL CHANGE option do not insert any records into SYSIBM.SYSCOPY.

Before and after row triggers are activated for SHRLEVEL CHANGE but not for SHRLEVEL NONE. Statement triggers for each row are also activated for SHRLEVEL CHANGE but not for SHRLEVEL NONE.

REPLACE

Indicates whether the table space and all its indexes need to be reset to empty before records are loaded. With this option, the newly loaded rows replace **all** existing rows of all tables in the table space, not just those of the table that you are loading. ForDB2 STOGROUP-defined data sets, the data set is deleted and

redefined with this option, unless you also specified the REUSE option. You must have LOAD authority for all tables in the table space where you perform LOAD REPLACE. If you attempt a LOAD REPLACE without this authority, you get an error message.

You cannot use REPLACE with the PART *integer* REPLACE option of INTO TABLE; you must either replace an entire table space by using the REPLACE option or replace a single partition by using the PART *integer* REPLACE option of INTO TABLE.

Specifying LOAD REPLACE (rather than PART *integer* REPLACE) tells LOAD to serialize at the table space level. If you want to serialize at the partition level, specify PART *integer* REPLACE. See the information about specifying REPLACE at the partition level under the keyword descriptions for INTO TABLE.

Restrictions:

- LOAD REPLACE is not allowed on a table that is defined with data versioning.
- LOAD REPLACE is not allowed on a table space after RECOVER was run on that table space to a point in time before pending definition changes were materialized. Before running LOAD REPLACE, you need to run REORG on the entire table space to complete the point-in-time recovery process.
- LOAD REPLACE is not allowed on an archive-enabled table. (LOAD REPLACE is allowed on the table space that contains the archive table.)

"Replacing data with LOAD" on page 313

COPYDDN (*ddname1***,***ddname2***)**

Specifies the DD statements for the primary (*ddname1*) and backup (*ddname2*) copy data sets for the image copy.

ddname is the DD name.

The **default** value is **SYSCOPY** for the primary copy. No default exists for the backup copy.

The COPYDDN keyword can be specified only with REPLACE. A full image copy data set (SHRLEVEL REFERENCE) is created for the table or partitions that are specified when LOAD executes. The table space or partition for which an image copy is produced is not placed in COPY-pending status.

Image copies that are taken during LOAD REPLACE are not recommended for use with RECOVER TOCOPY because these image copies might contain unique index violations, referential constraint violations, or index evaluation errors.

If you specify COPYDDN when loading a table with XML data, an inline copy is taken only of the base table space, not the XML table space.

If you specify COPYDDN when loading a table with LOB columns, DB2 does not create a copy of any index, LOB table space, or XML table space. You must perform these tasks separately.

The COPYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

RECOVERYDDN *ddname3*,*ddname4*

Specifies the DD statements for the primary (*ddname3*) and backup (*ddname4*) copy data sets for the image copy at the recovery site.

ddname is the DD name.

You cannot have duplicate image copy data sets. The same rules apply for RECOVERYDDN and COPYDDN.

The RECOVERYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

FLASHCOPY

Specifies whether FlashCopy technology is used to create a copy of the object. Valid values are YES, NO, or CONSISTENT. When FlashCopy is used, a separate data set is created for each partition or piece of the object.

Specify YES or CONSISTENT only if the DB2 data sets are on FlashCopy Version 2 disk volumes.

The FlashCopy specifications on the utility control statement override any specifications for FlashCopy that are defined by using the DB2 subsystem parameters. If the FlashCopy subsystem parameters specify the use of FlashCopy as the default behavior of this utility, the FLASHCOPY option can be omitted from the utility control statement.

Important: If the input data set is less than one cylinder, FlashCopy technology might not be used for copying the objects regardless of the FLASHCOPY settings. The copy is performed by IDCAMS if FlashCopy is not used.

NO Specifies that no FlashCopy is made. NO is the default value for FLASHCOPY.

YES

Specifies that FlashCopy technology is used to copy the object.

Important: Under the following circumstances, the COPY utility might not use FlashCopy even though YES is specified:

- FlashCopy Version 2 disk volumes are not available
- The source tracks are already the target of a FlashCopy operation
- The target tracks are the source of a FlashCopy operation
- The maximum number of relationships for the copy is exceeded

In the event that FlashCopy is not used, the LOAD utility uses traditional I/O methods to copy the object, which can result in longer than expected execution time.

CONSISTENT

When SHRLEVEL CHANGE is specified, specifies that FlashCopy technology is used to copy the object and that any uncommitted work included in the copy is backed out of the copy to make the copy consistent. If SHRLEVEL NONE is specified, the image copy is already consistent and you do not need to specify CONSISTENT.

A consistent FlashCopy image copy can by used for recovery without also requiring a sequential format image copy.

Specifying FLASHCOPY CONSISTENT requires additional time and system resources during utility processing, because the utility must read the logs and apply the changes to the image copy. Similarly, recovering from a consistent FlashCopy image copy also requires additional time and system resources to read the logs and reapply work that was previously backed out.

Restriction: CONSISTENT cannot be specified when copying objects that have been defined with the NOT LOGGED attribute. If CONSISTENT is specified for an object that is defined with the NOT LOGGED attribute, the utility does not make a copy of the object and issues message DSNU076I with return code 8.

FCCOPYDDN
Specifies the template to be used to create the FlashCopy image copy data set names. If a value is not specified for FCCOPYDDN on the LOAD control statement when FlashCopy is used, the value specified on the FCCOPYDDN subsystem parameter determines the template to be used.

(*template-name***)**
The data set names for the FlashCopy image copy are allocated according to the template specification. For table space or index space level FlashCopy image copies, because a data set is allocated for each partition or piece, ensure that the data set naming convention in the template specification is unique enough. Use the &DSNUM variable, which resolves to a partition number or piece number at execution time.

STATISTICS
Specifies the gathering of statistics for a table space, index, or both; the statistics are stored in the DB2 catalog.

If you specify the STATISTICS keyword with no other *statistics-spec* or *correlation-stats-spec* options, DB2 gathers only table space statistics. Statistics are collected on a base table space, but not on a LOB table space or XML table space.

Restrictions:

- If you specify STATISTICS for encrypted data, DB2 might not provide useful statistics on this data.
- You cannot specify STATISTICS if the named table is a table clone.

TABLE
Specifies the table for which column information is to be gathered. All tables must belong to the table space of the specified table or tables in the INTO TABLE clause.

(ALL)
Specifies that information is to be gathered for all columns of the table or tables that are being loaded.

(*table-name***)**
Specifies the tables for which column information is to be gathered. If you omit the qualifier, the user identifier for the utility job is used. Enclose the table name in quotation marks if the name contains a blank.

If you specify more than one table, you must repeat the TABLE option. Multiple TABLE options must be specified entirely before or after any INDEX keyword that may also be specified. For example, the INDEX keyword may not be specified between any two TABLE keywords.

SAMPLE *integer*
Indicates the percentage of rows that LOAD is to sample when collecting statistics on non-leading-indexed columns of an index or non-indexed columns. You can specify any value from 1 through 100. The **default** value is **25**.

COLUMN
Specifies the columns for which column information is to be gathered.

You can specify this option only if you specify the particular tables for which statistics are to be gathered (TABLE (table-name)). If you specify particular tables and do not specify the COLUMN option, the default, COLUMN(ALL), is used. If you do not specify a particular table when using the TABLE option, you cannot specify the COLUMN option; however, COLUMN(ALL) is assumed.

(ALL)
Specifies that statistics are to be gathered for all columns in the table.

(*column-name***, ...)**
Specifies the columns for which statistics are to be gathered.

You can specify a list of column names; the maximum is 10. If you specify more than one column, separate each name with a comma.

INDEX
Specifies indexes for which information is to be gathered. Column information is gathered for the first column of the index. All the indexes must be associated with the same table or tables in the INTO TABLE clause.

(ALL)
Specifies that the column information is to be gathered for all indexes that are defined on tables in the table space.

(*index-name***)**
Specifies the indexes for which information is to be gathered. Enclose the index name in quotation marks if the name contains a blank.

COLGROUP (*column-name***, ...)**
Indicates that the specified set of columns are treated as a group. This option enables inline statistics to collect a cardinality value on the specified column group. Inline statistics ignores COLGROUP when processing XML table spaces and indexes.

When you specify the COLGROUP keyword, inline statistics collects correlation statistics for the specified column group. If you want inline statistics to also collect distribution statistics, specify the FREQVAL option with COLGROUP.

(*column-name*, ...) specifies the names of the columns that are part of the column group.

To specify more than one column group, repeat the COLGROUP option.

Restriction: The length of the COLGROUP value cannot exceed the maximum length of the COLVALUE column in the SYSIBM.SYSCOLDIST catalog table.

FREQVAL
Indicates, when specified with the COLGROUP option, that frequency statistics are also to be gathered for the specified group of columns. (COLGROUP indicates that cardinality statistics are gathered.) One group of statistics is gathered for each column. You must specify COUNT integer with COLGROUP

FREQVAL. The LOAD utility ignores FREQVAL MOST/LEAST/BOTH when processing XML table spaces and indexes.

COUNT *integer*
Indicates the number of frequently occurring values to be collected from the specified column group. For example, COUNT 20 means that DB2 collects 20 frequently occurring values from the column group. You must specify a value for integer; no default value is assumed. Be careful when specifying a high value for COUNT. Specifying a value of 1000 or more can increase the prepare time for some SQL statements.

MOST
Indicates that the utility is to collect the most frequently occurring values for the specified set of columns when COLGROUP is specified.

BOTH
Indicates that the utility is to collect the most and the least frequently occurring values for the specified set of columns when COLGROUP is specified.

LEAST
Indicates that the utility is to collect the least frequently occurring values for the specified set of columns when COLGROUP is specified.

HISTOGRAM
Indicates, when specified with the COLGROUP option, that histogram statistics are to be gathered for the specified group of columns. Inline statistics for XML table spaces and indexes do not include histogram statistics.

Histogram statistics that you collect through LOAD are not the same as histogram statistics that you collect through RUNSTATS. Histogram statistics that you collect with LOAD are only rough estimates. To obtain more exact statistics, use RUNSTATS.

NUMQUANTILES *integer*
Indicates how many quantiles that the utility collects. The integer value must be greater than or equal to one. The number of quantiles that you specify must never exceed the total number of distinct values in the column or the column group. The maximum number of quantiles is 100.

When the NUMQUANTILES keyword is omitted, NUMQUANTILES takes a default value of 100. Based on the number of records in the table, the number of quantiles is readjusted down to an optimal number.

KEYCARD
The KEYCARD option is deprecated in the LOAD control statement and no longer needs to be specified to collect statistics on the values in the key columns of an index.

When the STATISTICS and INDEX options are specified, the LOAD utility automatically collects all of the distinct values in all of the 1 to *n* key column combinations for the indexes being rebuilt.*n* is the number of columns in the index. With the collection of inline statistics for indexes, this functionality is performed by default and cannot be disabled.

The LOAD utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when STATISTICS and INDEX are specified.

FREQVAL
Controls the collection of frequent-value statistics. If you specify FREQVAL, it must be followed by two additional keywords:

NUMCOLS
Indicates the number of key columns that are to be concatenated together when collecting frequent values from the specified index. Specifying '3' means that frequent values are to be collected on the concatenation of the first three key columns. The **default** value is **1**, which means that DB2 collects frequent values on the first key column of the index.

COUNT
Indicates the number of frequent values that are to be collected. Specifying '15' means that DB2 collects 15 frequent values from the specified key columns. The **default** value is **10**.

HISTOGRAM
Indicates that histogram statistics are requested for the specified index.

NUMCOLS
The number of key columns that are to be concatenated when collecting histogram statistics from the specified index.

NUMQUANTILES
The integer values that follows NUMQUANTILES indicates the number quantiles are requested. The integer value must be greater than or equal to 1.

Histogram statistics can be collected only on keys with the same order. If the specified key columns for histogram statistics are of mixed or random order, a DSNU633I warning message is issued.

Histogram statistics that you collect through LOAD are not the same as histogram statistics that you collect through RUNSTATS. Histogram statistics that you collect with LOAD are only rough estimates. To obtain more exact statistics, use RUNSTATS.

Related information:

Histogram statistics (DB2 Performance)

DSNU633I (DB2 Messages)

REPORT
Indicates whether a set of messages is to be generated to report the collected statistics.

NO Indicates that the set of messages is not sent to SYSPRINT as output.

YES
Indicates that the set of messages is sent to SYSPRINT as output. The generated messages are dependent on the combination of keywords (such as INDEX, TABLE, and COLUMN) that are specified with the STATISTICS option. However, these messages are not dependent on the specification of the UPDATE option. REPORT YES always generates a report of SPACE and ACCESSPATH statistics.

UPDATE
Indicates whether the collected statistics are to be inserted into the catalog tables. UPDATE also allows you to select statistics that are used for access path selection or statistics that are used by database administrators.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that updates are to be made only to the catalog table columns that provide statistics that are used for access path selection.

SPACE
Indicates that updates are to be made only to the catalog table columns that provide statistics to help database administrators assess the status of a particular table space or index.

NONE
Indicates that no catalog tables are to be updated with the collected statistics. This option is valid only when REPORT YES is specified.

HISTORY
Records all catalog table inserts or updates to the catalog history tables.

The default is supplied by the value that is specified in STATISTICS HISTORY on panel DSNTIP6.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that updates are to be made only to the catalog history table columns that provide statistics that are used for access path selection.

SPACE
Indicates that only space-related catalog statistics are to be updated in catalog history tables.

NONE
Indicates that no catalog history tables are to be updated with the collected statistics.

FORCEROLLUP
Specifies whether aggregation or rollup of statistics is to take place when RUNSTATS is executed even if some parts are empty. This keyword enables the optimizer to select the best access path.

YES
Indicates that forced aggregation or rollup processing is to be done, even though some parts might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all parts.

If data is not available for all parts, DSNU623I message is issued if the installation value for STATISTICS ROLLUP on panel DSNTIP6 is set to NO.

KEEPDICTIONARY
Prevents the LOAD utility from building a new compression dictionary. LOAD retains the current compression dictionary and uses it for compressing the input data. This option eliminates the cost that is associated with building a new dictionary.

The KEEPDICTIONARY keyword is ignored for XML table spaces. If you specify REPLACE, any existing dictionary for the XML table space or partition is deleted. If you do not specify REPLACE, any existing dictionary for the XML table space or partition is saved.

DB2 ignores the KEEPDICTIONARY option during execution of a REORG or LOAD REPLACE that changes the table space from basic row format to reordered row format.

This keyword is valid only if the table space that is being loaded has the COMPRESS YES attribute.

If the table space or partition is empty, DB2 performs one of these actions:

- DB2 builds a dictionary if a compression dictionary does not exist, but only if the table space is not a simple table space.
- DB2 keeps the dictionary if a compression dictionary exists.

If RESUME NO and REPLACE are specified when the table space or partition is not empty, DB2 performs the same actions as it does when the table space or partition is empty.

If the table space or partition is not empty and RESUME YES is specified, DB2 performs one of these actions:

- DB2 does not build a dictionary if a compression dictionary does not exist.
- DB2 keeps the dictionary if a compression dictionary exists.

Note: You must use KEEPDICTIONARY to ensure that the compression dictionary is maintained.

Related information:

"Compressing data by using the LOAD utility" on page 328

REUSE

Specifies (when used with REPLACE) that LOAD is to logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE, DB2 deletes and redefines DB2-managed data sets to reset them.

REUSE must be accompanied by REPLACE to do the logical reset for all data sets. However, if you specify REUSE for the table space and REPLACE only at the partition level, only the replaced partitions are logically reset.

If a data set has multiple extents, the extents are not released if you specify the REUSE parameter.

LOG

Indicates whether logging is to occur during the RELOAD phase of the load process.

YES

Specifies normal logging during the load process. All records that are loaded are logged. If the table space has the NOT LOGGED attribute, DB2 does the LOAD with no logging.

NO Specifies no logging of data during the load process. If the table space has the LOGGED attribute, the NO option sets the COPY-pending restriction against the table space or partition that the loaded table resides in. No table or partition in the table space can be updated by SQL until the restriction is removed. For ways to remove the restriction, see "Resetting COPY-pending status" on page 353.

If you load a single partition of a partitioned table space and the table space has a secondary index, some logging might occur during the build

phase as DB2 logs any changes to the index structure. This logging allows recoverability of the secondary index in case an abend occurs, and it also allows concurrency.

DB2 treats table spaces that were created as NOT LOGGED as if you specified LOG NO. If you specify LOG NO without specifying COPYDDN, the base table space is placed in COPY-pending status. If XML columns are nullable and not loaded, only the base table space is placed in COPY-pending status.

A LOB table space affects logging while DB2 loads a LOB column regardless of whether the LOB table space was defined with LOG YES or LOG NO.

NOCOPYPEND
Specifies that LOAD is not to set the table space in the COPY-pending status, even though LOG NO was specified. A NOCOPYPEND specification does not turn on or change any informational COPY-pending (ICOPY) status for indexes. A NOCOPYPEND specification will not turn off any COPY-pending status that was set prior to the LOAD. Normal completion of a LOAD LOG NO NOCOPYPEND job returns a 0 code if no other errors or warnings exist.

DB2 ignores a NOCOPYPEND specification if you also specified COPYDDN to make a local-site inline image copy during the LOAD. If the table space has the NOT LOGGED attribute, NOCOPYPEND is ignored.

Attention: Specify the NOCOPYPEND option only if the data in the table space can be easily re-created by another LOAD job if the data is lost. If you do not take an image copy following the LOAD, you cannot recover the table space by using the RECOVER utility, and you might lose data.

WORKDDN (*ddname1***,***ddname2***)**
Specifies the DD statements for the temporary work file for sort input and sort output. Temporary work files for sort input and output are required if the LOAD involves tables with indexes.

ddname1 is the DD name for the temporary work file for sort input. The **default** value is **SYSUT1**.

ddname2 is the DD name for the temporary work file for sort output. The **default** value is **SORTOUT**.

The WORKDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name. For more information about TEMPLATE specifications, see Chapter 35, “TEMPLATE,” on page 789.

SORTKEYS
Specifies that index keys are to be sorted in parallel during the SORTBLD phase to improve performance.

integer
Specifies an *integer* to provide an estimate of the number of index keys that

are to be sorted. Integer must be a positive integer between 0 and 562 949 953 421 311. The **default** value is **0** if any of the following conditions are true:

- The target table has no index and SHRLEVEL is NONE.
- The target table has one index.
- The input is on tape, a cursor, a PDS member, or for SYSREC DD *.

NO Indicates that the SORTKEYS default is to be turned off.

For sequential data sets on disk, LOAD computes the default value for SORTKEYS based on the input data set size.

If the NUMRECS keyword is specified at the table level in the same LOAD statement, you cannot specify an integer value on the SORTKEYS keyword. To turn off parallel sorts, you can specify SORTKEYS NO when the NUMRECS keyword is specified. The NUMRECS keyword is specified at the table level to improve the estimation of work file data set sizes when loading data into multi-table table spaces with uneven distribution of rows between the tables.

Related information:

"Improving LOAD performance" on page 334

FORMAT

Identifies the format of the input record. If you use FORMAT UNLOAD, FORMAT INTERNAL, or FORMAT SQL/DS, it uniquely determines the format of the input, and no field specifications are allowed in an INTO TABLE option.

If you omit FORMAT, the format of the input data is determined by the rules for field specifications.If you specify FORMAT DELIMITED, the format of the input data is determined by the rules that are described in Appendix I, "Delimited file format," on page 1203.

UNLOAD

The FORMAT UNLOAD option is deprecated, and the alternative is running FORMAT INTERNAL.Specifies that the input record format is compatible with the DB2 unload format. (The DB2 unload format is the result of REORG with the UNLOAD ONLY option.)

Input records that were unloaded by the REORG utility are loaded into the tables from which they were unloaded, if an INTO TABLE option specifies each table. Do not add columns or change column definitions of tables between the time you run REORG UNLOAD ONLY and LOAD FORMAT UNLOAD.

Any WHEN clause on the LOAD FORMAT UNLOAD statement is ignored; DB2 reloads the records into the same tables from which they were unloaded. Not allowing a WHEN clause with the FORMAT UNLOAD clause ensures that the input records are loaded into the proper tables. Input records that cannot be loaded are discarded.

If the DCB RECFM parameter is specified on the DD statement for the input data set, and the data set format has not been modified since the REORG UNLOAD (ONLY) operation, the record format must be variable (RECFM=V).

SQL/DS

Specifies that the input record format is compatible with the SQL/DS

unload format. The data type of a column in the table that is to be loaded must be the same as the data type of the corresponding column in the SQL/DS table.

If the SQL/DS input contains rows for more than one table, the WHEN clause of the INTO TABLE option indicates which input records are to be loaded into which DB2 table.

LOAD cannot load SQL/DS strings that are longer than the DB2 limit.

SQL/DS data that has been unloaded to disk under DB2 Server for VSE & VM resides in a simulated z/OS-type data set with a record format of VBS. Consider this format when transferring the data to another system that is to be loaded into a DB2 table (for example, the DB2 Server for VSE & VM. FILEDEF must define it as a z/OS-type data set). Processing the data set as a standard CMS file puts the SQL/DS record type field at the wrong offset within the records; LOAD is unable to recognize them as valid SQL/DS input.

INTERNAL

Specifies that the input record format is DB2 internal format. DB2 internal format is the format that is produced by running UNLOAD with the FORMAT INTERNAL option. LOAD does no validation of the data to ensure that it is in DB2 internal format.

When FORMAT INTERNAL is specified:

- LOAD ignores any field specifications in the LOAD control statement.
- LOAD does no data conversion.

Restrictions:

- The input data must be in decompressed format.
- LOAD can load only one table at a time when FORMAT INTERNAL is specified.
- LOAD does not populate LOB or XML columns when FORMAT INTERNAL is specified. LOAD puts the base table space in advisory CHECK-pending status.
- FORMAT INTERNAL cannot be specified with any of the following options:
  - ASCII
  - CCSID
  - CONTINUEIF
  - DECFLOAT_ROUNDMODE
  - EBCDIC
  - FLOAT
  - OVERRIDE(IDENTITY)
  - IGNOREFIELDS
  - INCURSOR
  - NOSUBS
  - SHRLEVEL CHANGE
  - UNICODE
  - WHEN

DELIMITED

Specifies that the input data file is in a delimited format. When data is in a

delimited format, all fields in the input data set are character strings or external numeric values. In addition, each column in a delimited file is separated from the next column by a column delimiter character.

For each of the delimiter types that you can specify, you must ensure that the delimiter character is specified in the code page of the source data. The delimiter character can be specified as either a character or hexadecimal constant. For example, to specify '#' as the delimiter, you can specify either COLDEL '#' or COLDEL X'23'. If the utility statement is coded in a character type that is different from the input file, such as a utility statement that is coded in EBCDIC and input data that is in Unicode, you should specify the delimiter character in the utility statement as a hexadecimal constant, or the result can be unpredictable.

You cannot specify the same character for more than one type of delimiter (COLDEL, CHARDEL, and DECPT). For more information about delimiter restrictions, see "Loading delimited files" on page 323.

Unicode input data for FORMAT DELIMITED must be UTF-8, CCSID 1208.

If you specify the FORMAT DELIMITED option, you cannot use any of the following options:
- CONTINUEIF
- INCURSOR
- Multiple INTO TABLE statements
- WHEN

Also, LOAD ignores any specified POSITION statements within the LOAD utility control statement.

For more information about using delimited output and delimiter restrictions, see "Loading delimited files" on page 323. For more information about delimited files see Appendix I, "Delimited file format," on page 1203.

COLDEL *coldel*
Specifies the column delimiter that is used in the input file. The **default** value is a comma (,). For most ASCII and UTF-8 data, this value is X'2C', and for most EBCDIC data, this value is a X'6B'.

CHARDEL *chardel*
Specifies the character string delimiter that is used in the input file. The **default** value is a double quotation mark ("). For most ASCII and UTF-8 data, this value is X'22', and for most EBCDIC data, this value is X'7F'.

To delimit character strings that contain the character string delimiter, repeat the character string delimiter where it is used in the character string. LOAD interprets any pair of character delimiters that are found between the enclosing character delimiters as a single character. For example, the phrase `"what a ""nice warm"" day"` is interpreted as `what a "nice warm" day`. The LOAD utility recognizes these character delimiter pairs for only CHAR, VARCHAR, and CLOB fields.

Character string delimiters are required only when the string contains the CHARDEL character. However, you can put the character string delimiters around other character strings. Data that has been unloaded in delimited format by the UNLOAD utility includes character string delimiters around all character strings.

DECPT*decpt*
Specifies the decimal point character that is used in the input file. The **default** value is a period (.). For most ASCII and UTF-8 data, this value is X'2E', and for most EBCDIC data, this value is X'4B'.

Note: If you use an application defaults load module (either DSNHDECP, which is the default, or a user-specified application defaults load module), ensure that the specified decimal value is the same as the decimal value that is used in the input data. You must specify the decimal value to match the decimal value that is used in the input data.

SPANNED
Indicates whether records are to be loaded from a VBS data set in spanned record format.

YES
Indicates that the LOAD utility is to load data from spanned records.

The input data set must be in spanned record format and all LOB and XML data must be at the end of the record.

You must provide a field specification list with all LOB and XML fields at the end of the record. For LOB and XML columns, specify POSITION(*).

If you specify FORMAT SPANNED YES, do not reference LOB or XML data in the *field-selection-criterion* of a WHEN clause.

You cannot specify the INCURSOR option with SPANNED YES.

If you specify FORMAT SPANNED YES, the LOAD utility does not use parallel processing.

NO Indicates that the LOAD utility is not to load data in spanned record format.

Related information:

"Unloading data in spanned record format" on page 862

FLOAT
Specifies that LOAD is to expect the designated format for floating point numbers.

(S390)
Specifies that LOAD is to expect that floating point numbers are provided in System/390® hexadecimal floating point (HFP) format. **(S390)** is the format that DB2 stores floating point numbers in. It is also the **default** value if you do not explicitly specify the FLOAT keyword.

(IEEE)
Specifies that LOAD is to expect that floating point numbers are provided in IEEE binary floating point (BFP) format.

When you specify FLOAT(IEEE), DB2 converts the BFP data to HFP format as the data is being loaded into the DB2 table. If a conversion error occurs while DB2 is converting from BFP to HFP, DB2 places the record in the discard file.

FLOAT(IEEE) is mutually exclusive with any specification of the FORMAT keyword. If you specify both FLOAT(IEEE) and FORMAT, DB2 issues message DSNU070I.

BFP format is sometimes called IEEE floating point.

EBCDIC
Specifies that the input data file is EBCDIC. The default is EBCDIC.

ASCII
Specifies that the input data file is ASCII. Numeric, date, time, and timestamp internal formats are not affected by the ASCII option.

UNICODE
Specifies that the input data file is Unicode. The UNICODE option does not affect the numeric internal formats.

CCSID
Specifies up to three coded character set identifiers (CCSIDs) for the input file. The first value specifies the CCSID for SBCS data that is found in the input file, the second value specifies the CCSID for mixed DBCS data, and the third value specifies the CCSID for DBCS data. If any of these values is specified as 0 or omitted, the CCSID of the corresponding data type in the input file is assumed to be the same as the installation default CCSID. If the input data is EBCDIC, the omitted CCSIDs are assumed to be the EBCDIC CCSIDs that are specified at installation, and if the input data is ASCII, the omitted CCSIDs are assumed to be the ASCII CCSIDs that are specified at installation. If the CCSIDs of the input data file do not match the CCSIDs of the table that is being loaded, the input data is converted to the table CCSIDs before being loaded.

integer is any valid CCSID specification.

If the input data is Unicode, the default CCSID values are the Unicode CCSIDs that are specified at system installation.

NOSUBS
Specifies that LOAD is not to accept substitution characters in a string.

Place a substitution character in a string when that string is being converted from ASCII to EBCDIC, or when the string is being converted from one CCSID to another. For example, this substitution occurs when a character (sometimes referred to as a code point) that exists in the source CCSID (code page) does not exist in the target CCSID (code page).

When you specify the NOSUBS option and the LOAD utility determines that a substitution character has been placed in a string as a result of a conversion, it performs one of the following actions:

- **If discard processing is active:** DB2 issues message DSNU310I and places the record in the discard file.
- **If discard processing is not active:** DB2 issues message DSNU334I, and the utility abnormally terminates.

ENFORCE
Specifies whether LOAD is to enforce check constraints and referential constraints, except informational referential constraints, which are not enforced.

CONSTRAINTS
Indicates that constraints are to be enforced. If LOAD detects a violation, it deletes the errant row and issues a message to identify it. If you specify this option and referential constraints exist, sort input and sort output data sets must be defined.

NO Indicates that constraints are not to be enforced. This option places the target table space in the CHECK-pending status if at least one referential constraint or check constraint is defined for the table.

ERRDDN *ddname*
Specifies the DD statement for a work data set that is being used during error processing. Information about errors that are encountered during processing is stored in this data set. A SYSERR data set is required if you request discard processing.

ddname is the DD name.

The default value is **SYSERR**.

The ERRDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name. For more information about TEMPLATE specifications, see Chapter 35, "TEMPLATE," on page 789.

MAPDDN *ddname*
Specifies the DD statement for a work data set that is to be used during error processing. The work data set is used to correlate the identifier of a table row with the input record that caused an error. A SYSMAP data set is required if you specify ENFORCE CONSTRAINTS and the tables have a referential relationship, or if you request discard processing when loading one or more tables that contain unique indexes or extended indexes.

ddname is the DD name.

The default value is **SYSMAP**.

The MAPDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name. For more information about TEMPLATE specifications, see Chapter 35, "TEMPLATE," on page 789.

DISCARDDN *ddname*
Specifies the DD statement for a discard data set that is to hold copies of records that are not loaded (for example, if they contain conversion errors). The discard data set also holds copies of records that are loaded and then removed (because of unique index errors, referential or check constraint violations, or index evaluation errors). Flag input records for discarding during RELOAD, INDEXVAL, and ENFORCE phases. However, the discard data set is not written until the DISCARD phase when the flagged records are copied from the input data set to the discard data set. The discard data set must be a sequential data set that can be written to by BSAM, with the same record format, record length, and block size as the input data set.

ddname is the DD name.

The default value is **SYSDISC**.

If you omit the DISCARDDN option, the utility application program saves discarded records only if a SYSDISC DD statement is in the JCL input.

The DISCARDDN keyword is not supported if you use a BatchPipes® file as an input to LOAD, using INDDN name for TEMPLATE SUBSYS.

The DISCARDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

DISCARDS *integer*
Specifies the maximum number of source records that are to be written on the discard data set. *integer* can range from 0 to 2147483647. If the discard maximum is reached, LOAD abnormally terminates, the discard data set is empty, and you cannot see which records were discarded. You can either restart the job with a larger limit, or terminate the utility.

DISCARDS 0 specifies that you do not want to set a maximum value. The entire input data set can be discarded.

The default value is **0**.

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by the external sort program. You can specify any disk device type that is acceptable to the DYNALLOC parameter of the SORT or OPTION options for the sort program.

If you omit SORTDEVT and a sort is required, you must provide the DD statements that the sort application program needs for the temporary data sets.

A TEMPLATE specification does not dynamically allocate sort work data sets. The SORTDEVT keyword controls dynamic allocation of these data sets.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated by the sort application program.

integer is the number of temporary data sets that can range from 2 to 255.

If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program. In this case, the sort program uses its own default.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, if three indexes, SORTKEYS is specified, there are no constraints that limit parallelism, and SORTNUM is specified as 8, a total of 24 sort work data sets are allocated for a job.

Each sort work data set consumes both above-the-line and below-the-line virtual storage, so if you specify a value for SORTNUM that is too high, the utility might decrease the degree of parallelism due to virtual storage constraints, and possibly decreasing the degree down to one, meaning no parallelism.

Important: The SORTNUM keyword will not be considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

CONTINUEIF
Indicates that you want to be able to treat each input record as a portion of a larger record. After CONTINUEIF, write a condition in one of the following forms:

```
(start:end) = X'byte-string'
(start:end) = 'character-string'
```

If the condition is true in any record, the next record is concatenated with it before loading takes place. You can concatenate any number of records into a larger record, up to a maximum size of 32767 bytes.

Character-string constants should be specified in LOAD utility control statements in the character set that matches the input data record. Specify

EBCDIC constants in the LOAD control statement if your data is in EBCDIC and specify UNICODE constants if your data is in UNICODE. You may also code the CONTINUEIF condition using the hexadecimal form. For example, use `(1:1)=X'31'` rather than `(1:1)='1'`.

(*start:end***)**
Specifies column numbers in the input record; the first column of the record is column 1. The two numbers tell the starting and ending columns of a continuation field in the input record.

Other field position specifications (such as those for WHEN, POSITION, or NULLIF) refer to the field position within the final assembled load record, not within the input record.

The continuation field is removed from the input record and is not part of the final load record.

If you omit *:end*, DB2 assumes that the length of the continuation field is the length of the byte string or character string. If you use *:end*, and the length of the resulting continuation field is not the same as the length of the byte string or character string, the shorter string is padded. Character strings are padded with blanks. Hexadecimal strings are padded with zeros.

X'*byte-string***'**
Specifies a string of hexadecimal characters. This byte-string value in the continuation field indicates that the next input record is a continuation of the current load record. Records with this byte-string value are concatenated until the value in the continuation field changes. For example, the following CONTINUEIF specification indicates that for any input records that have a value of X'FF'in column 72, LOAD is to concatenate that record with the next input record.

```
CONTINUEIF (72) = X'FF'
```

'*character-string***'**
Specifies a string of characters that has the same effect as X'*byte-string*'. For example, the following CONTINUEIF specification indicates that for any input records that have the string CC in columns 99 and 100, LOAD is to concatenate that record with the next input record.

```
CONTINUEIF (99:100) = 'CC'
```

DECFLOAT_ROUNDMODE
Specifies the rounding mode to use when DECFLOATs are manipulated. The following rounding modes are supported:

ROUND_CEILING
Round toward +infinity. The discarded digits are removed if they are all zero or if the sign is negative. Otherwise, the result coefficient should be incremented by 1 (rounded up).

ROUND_DOWN
Round toward 0 (truncation). The discarded digits are ignored.

ROUND_FLOOR
Round toward -infinity. The discarded digits are removed if they are all zero or positive. Otherwise, the sign is negative and the result coefficient should be incremented by 1 (rounded up).

ROUND_HALF_DOWN
Round to the nearest number. If equidistant, round down. If the discarded

digits are greater than 0.5, the result coefficient should be incremented by 1 (rounded up). The discarded digits are ignored if they are 0.5 or less.

ROUND_HALF_EVEN
Round to the nearest number. If equidistant, round so that the final digit is even. If the discarded digits are greater than .05, the result coefficient should be incremented by 1 (rounded up). The discarded digits are ignored if they are less than 0.5. If the result coefficient is .05 and the rightmost digit is even, the result coefficient is not altered. If the result coefficient is .05 and the rightmost digit is odd, the result coefficient should be incremented by 1 (rounded up).

ROUND_HALF_UP
Round to nearest. If equidistant, round up. If the discarded digits are greater than or equal to 0.5, the result coefficient should be incremented by 1 (rounded up). Otherwise the discarded digits are ignored.

ROUND_UP
Round away from 0. If all of the discarded digits are 0, the result is unchanged. Otherwise, the result coefficient should be incremented by 1 (rounded up).

If you do not specify DECFLOAT_ROUNDMODE, the LOAD statement uses the DFPDEFDM value in the application defaults load module as the default value. The application defaults load module is either DSNHDECP, which is the default, or a user-specified application defaults load module.

OVERRIDE
Allows unloaded data to be reloaded into the specified types of GENERATED ALWAYS columns.

SYSTEMPERIOD
Allows unloaded data to be reloaded into a GENERATED ALWAYS row-begin or row-end column. Row-begin and row-end columns are intended to be used in the definition of a system period, but the period does not need to exist when the SYSTEMPERIOD keyword is specified.

If you specify OVERRIDE(SYSTEMPERIOD) and include input field specifications in the LOAD statement, both the row-begin and row-end columns that can be used to define a system period must be specified. In the specification for these columns, the NULLIF and DEFAULTIF options are not allowed.

IDENTITY
Allows unloaded data to be reloaded into a GENERATED ALWAYS identity column.

If you specify OVERRIDE(IDENTITY) and include input field specifications in the LOAD statement, the identity column must be specified. In the specification for this column, the NULLIF and DEFAULTIF options are not allowed.

Specify OVERRIDE(IDENTITY) when you want to run LOAD with the INTO TABLE PART clause and a generated identity column is part of the partitioning index. (The generated identity column can be defined as GENERATED ALWAYS or GENERATED BY DEFAULT.)

TRANSID
Allows unloaded data to be reloaded into a GENERATED ALWAYS column that is defined as a transaction-start-ID column.

NONDETERMINISTIC
Allows unloaded data to be reloaded into a GENERATED ALWAYS column that is defined by a non-deterministic expression.

INDEXDEFER
Specifies whether index builds are done during the BUILD phase of LOAD, or are deferred until REBUILD INDEX is run manually. Deferring index builds is a way to improve LOAD performance, especially for LOAD with PART. If indexes are not built during LOAD, LOAD places the affected indexes in the REBUILD-pending state.

NONE
Specifies that indexes are built during the BUILD phase of LOAD.

ALL
Specifies that no indexes are built as part of a BUILD phase of the LOAD utility. Index builds are deferred until REBUILD INDEX is run manually. ALL is valid only if SHRLEVEL NONE is also specified.

NPI
Specifies that building of nonpartitioned indexes is not done as part of a BUILD phase of the LOAD utility. Nonpartitioned index builds are deferred until REBUILD INDEX is run manually. NPI is valid only if SHRLEVEL NONE is also specified.

NONUNIQUE
Specifies that building of only nonunique indexes is deferred. NONUNIQUE is valid only if ALL or NPI is also specified. If NONUNIQUE is not specified, building of unique and nonunique indexes is deferred. If unique indexes are defined on the tables that are being loaded, specify NONUNIQUE unless the data really is unique. REBUILD INDEX does not resolve duplicate keys for unique indexes.

When INDEXDEFER ALL or INDEXDEFER NPI is specified:

- If ENFORCE CONSTRAINTS is also specified, building of indexed foreign keys is not deferred.
- If RESUME is also specified, building of indexes that were created with DEFINE NO and are still undefined is not deferred. Building of undefined indexes is deferred only when REPLACE is specified.

IMPLICIT_TZ
Specifies the implicit time zone to use when the timestamp value that is being loaded does not contain a time zone, and the data type of the target column is TIMESTAMP WITH TIME ZONE.

'timezone-string'
Specifies the implicit time zone value. The time zone is the difference (in hours and minutes) between local time and UTC. The range of the hour component is -12 to 14, and the minute component is 00 to 59. The time zone is specified in the form ±th:tm, with values ranging from -12:59 to +14:00.

If you do not specify the IMPLICIT_TZ option, LOAD uses the value from the IMPLICIT_TIMEZONE DECP value. For more information about this DECP value, see IMPLICIT TIME ZONE field (IMPLICIT_TIMEZONE DECP value) (DB2 Installation and Migration).

INTO-TABLE-spec

The INTO-TABLE-spec control statement, with its multiple options, defines the function that the utility job performs. More than one table or partition for each table space can be loaded with a single invocation of the LOAD utility. At least one INTO TABLE statement is required for each table that is to be loaded. Each INTO TABLE statement:

- Identifies the table that is to be loaded
- Describes fields within the input record
- Defines the format of the input data set

All tables that are specified by INTO TABLE statements must belong to the same table space.

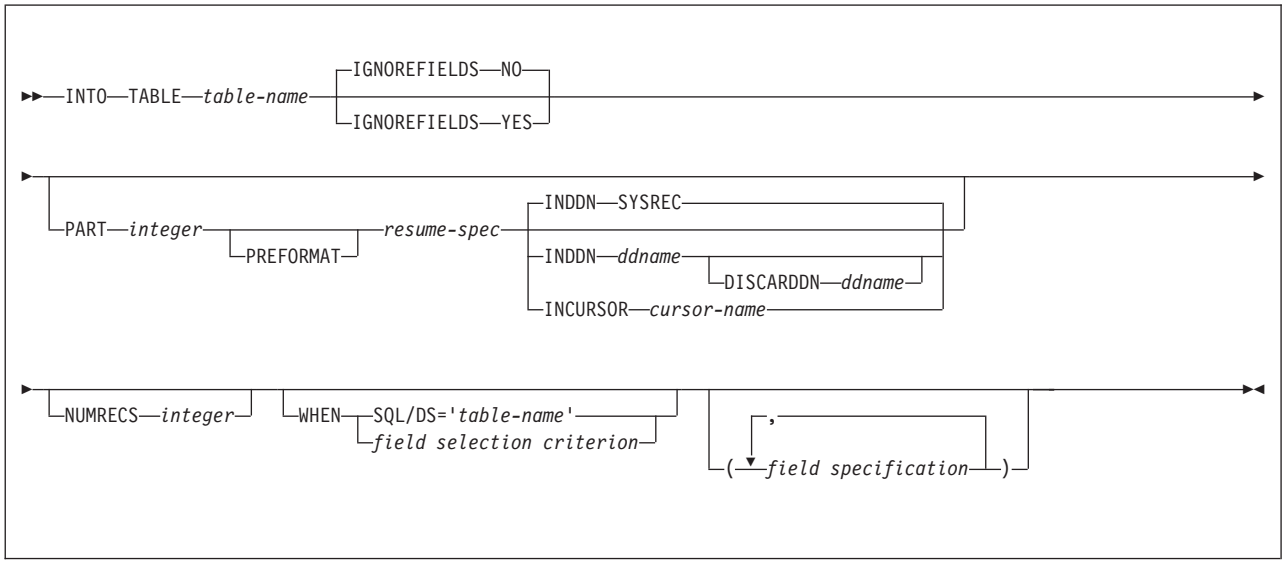
If the data is already in UNLOAD or SQL/DS format, and FORMAT UNLOAD or FORMAT SQL/DS is used on the LOAD statement, no field specifications are allowed.

Related information:

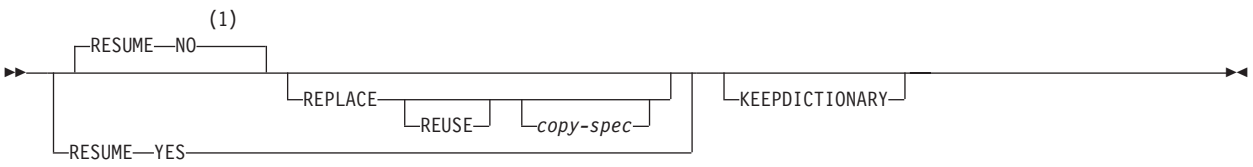
"Loading partitions" on page 319

When loading XML or LOB columns from a VBS data set, the LOB and XML values need to be at the end of the record as specified by a field specification list.

INTO-TABLE-spec:



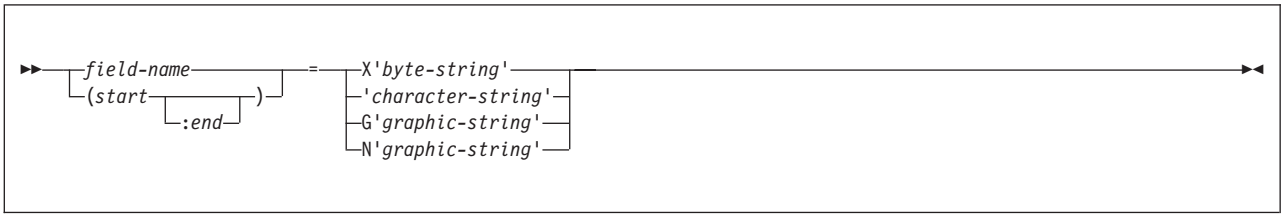
resume-spec:



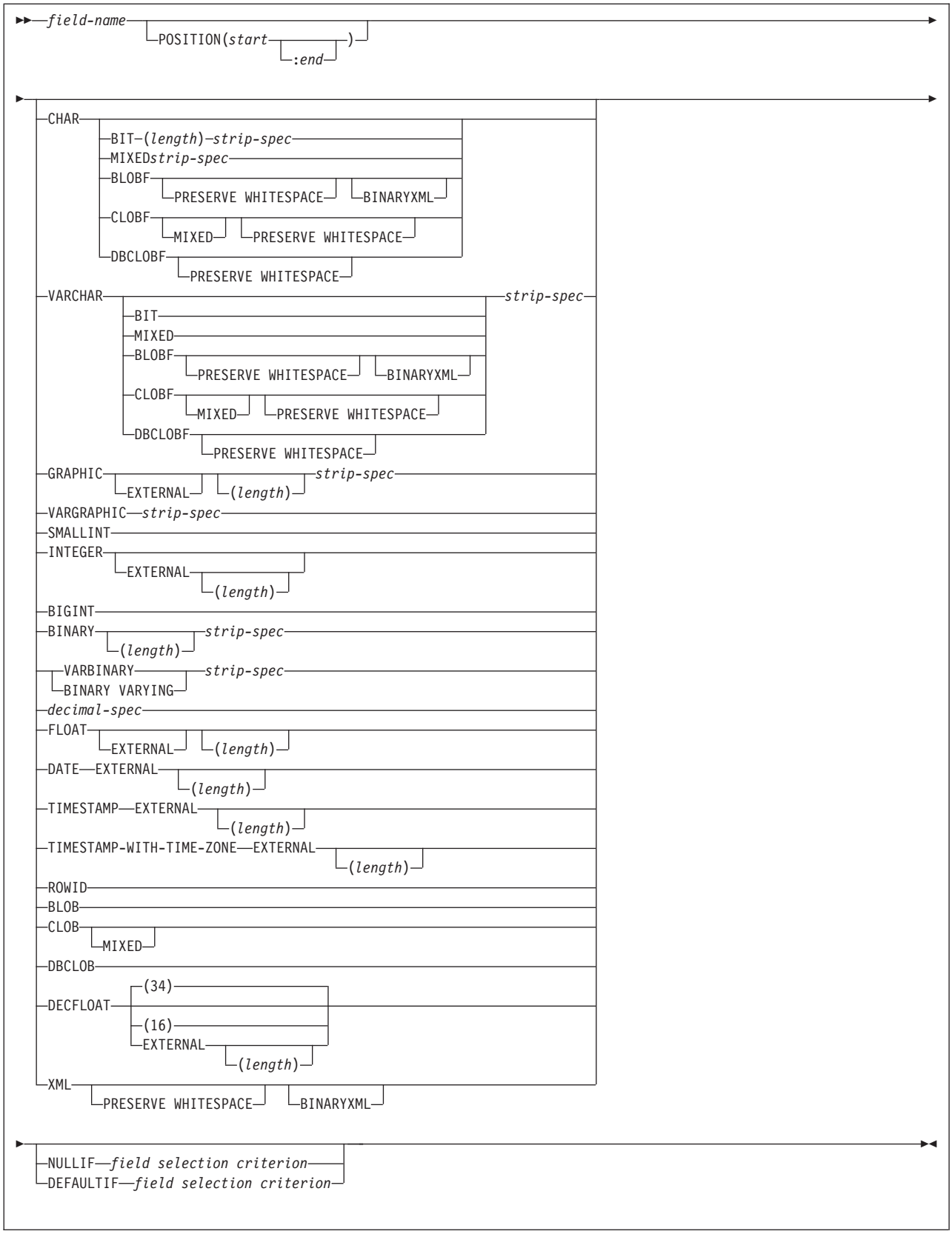
Notes:

1 The value specified in the INTO TABLE for RESUME or REPLACE overrides the default value for LOAD RESUME.

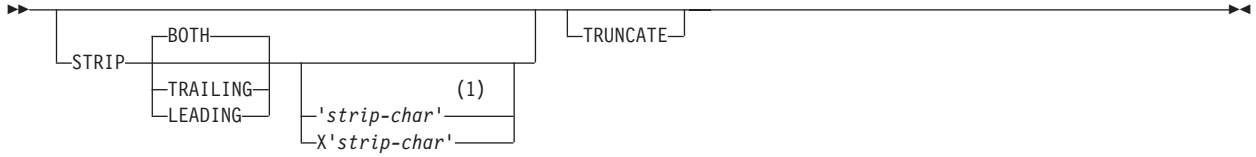
field selection criterion:



field specification:


field-name
POSITION(start
:end)
CHAR
BIT(length)strip-spec
MIXEDstrip-spec
BLOBF
PRESERVE WHITESPACE
BINARYXML
CLOBF
MIXED
PRESERVE WHITESPACE
DBCLOBF
PRESERVE WHITESPACE
VARCHAR
strip-spec
BIT
MIXED
BLOBF
PRESERVE WHITESPACE
BINARYXML
CLOBF
MIXED
PRESERVE WHITESPACE
DBCLOBF
PRESERVE WHITESPACE
GRAPHIC
EXTERNAL
(length)
strip-spec
VARGRAPHIC strip-spec
SMALLINT
INTEGER
EXTERNAL
(length)
BIGINT
BINARY
(length)
strip-spec
VARBINARY
BINARY VARYING
strip-spec
decimal-spec
FLOAT
EXTERNAL
(length)
DATE EXTERNAL
(length)
TIMESTAMP EXTERNAL
(length)
TIMESTAMP-WITH-TIME-ZONE EXTERNAL
(length)
ROWID
BLOB
CLOB
MIXED
DBCLOB
DECFLOAT
(34)
(16)
EXTERNAL
(length)
XML
PRESERVE WHITESPACE
BINARYXML
NULLIF field selection criterion
DEFAULTIF field selection criterion

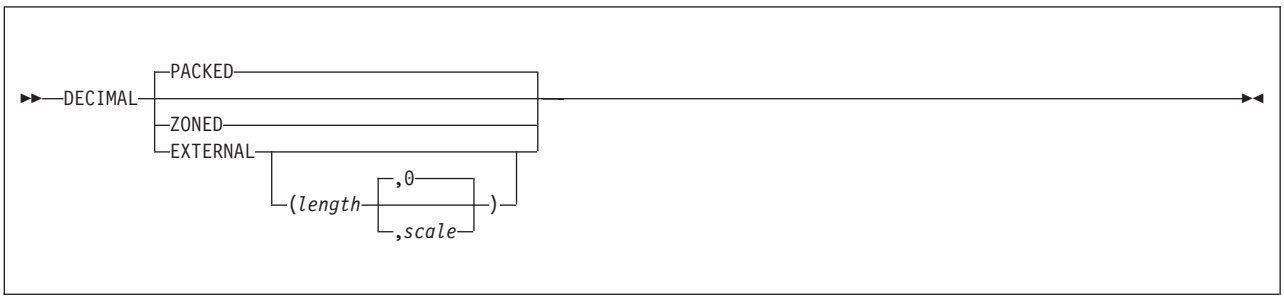
strip spec:



Notes:

1 If you specify GRAPHIC, BINARY, VARBINARY, or VARGRAPHIC, you cannot specify 'strip-char'. You can specify only X'strip-char'.

decimal spec:



Option descriptions for INTO TABLE

table-name
Specifies the name of the table that is to be loaded. The table must be described in the catalog.

The table must not be a catalog table or a system-maintained materialized query table.

If the table name is not qualified by a schema name, the authorization ID of the invoker of the utility job step is used as the schema qualifier of the table name. Enclose the table name in quotation marks if the name contains a blank.

Data from every LOAD record in the data set is loaded into the specified table unless:

- A WHEN clause is used, and the data does not match the field selection criterion.
- The FORMAT UNLOAD option is used on the LOAD statement, and the data comes from a table that is not specified in an INTO TABLE statement.
- A certain partition is specified, and the data does not belong to that partition.
- Data conversion errors occur.
- Any errors occur that are not generated by data conversion.

IGNOREFIELDS
Indicates whether LOAD is to skip fields in the input data set that do not correspond to columns in the target table. Examples of fields that do not correspond to table columns are the DSN_NULL_IND_*nnnnn*, DSN_ROWID, DSN_IDENTITY, and DSN_RCTIMESTAMP fields that are generated by the REORG utility.

NO Specifies that the LOAD process is not to skip any fields.

YES
Specifies that LOAD is to skip fields in the input data set that do not correspond to columns in the target table.

Specifying YES can be useful if each input record contains a variable-length field, followed by some variable-length data that you do not want to load and then some data that you want to load. Because of the variable-length field, you cannot use the POSITION keyword to skip over the variable-length data that you do not want to load. By specifying IGNOREFIELDS, you can give a field specification for the variable-length data that you do not want to load; and by giving it a name that is not one of the table column names, LOAD skips the field without loading it.

Use this option with care, because it also causes fields to be skipped if you intend to load a column but have misspelled the name.

NUMRECS
Indicates the number of input records for the specified table or table partition.

integer
A positive integer that is used as an estimate of the number of complete input records that are to be loaded into the specified table. The specified number refers to fully assembled input records when CONTINUEIF is used.

Use the NUMRECS keyword for multi-table table spaces to indicate the number of input records that will be loaded into each of the tables or table partitions.

Specifying the number of records improves the sizing of the sort work data sets that the utility requires when indexes are built in parallel. If the LOAD utility underestimates the size of the sort work data sets, the execution of the LOAD utility could fail.

You can also use the NUMRECS keyword when the input data set is located on tape or if only a fraction of the input records will be loaded.

If an integer value is specified on the SORTKEYS keyword at the table-space level, the NUMRECS keyword cannot be specified in the same LOAD statement.

If multiple tables or partitions are loaded in the same LOAD statement, the NUMRECS keyword must be specified either for all of the tables or partitions or for none of the tables or partitions.

PART *integer*
Specifies that data is to be loaded into a partition of a partitioned table space. This option is valid only for partitioned table spaces, not including partition-by-growth table spaces.

integer is the physical partition number for the partition into which records are to be loaded. The same partition number cannot be specified more than once if partition parallelism has been requested. Any data that is outside the range of the specified partition is not loaded. The maximum is 4096.

LOAD INTO PART *integer* is not allowed if:

- An identity column is part of the partitioning index, unless OVERRIDE(IDENTITY) is specified for the identity column GENERATED ALWAYS
- A row ID is part of the partitioning index
- The table space is partition-by-growth

For nonpartitioned secondary indexes, LOAD PART:

- Does not set the page set REBUILD-pending (PSRBD) status
- Does not consider PCTFREE or FREEPAGE attributes when inserting keys

PREFORMAT
Specifies that the remaining pages are to be preformatted up to the high-allocated RBA in the partition and its corresponding partitioning index space. The preformatting occurs after the data is loaded and the indexes are built.

RESUME
Specifies whether records are to be loaded into an empty or non-empty partition. For nonsegmented table spaces, space is not reused for rows that have been marked as deleted or by rows of dropped tables is not reused. If the RESUME option is specified at the table space level, the RESUME option is not allowed in the PART clause.

If you want the RESUME option to apply to the entire table space, use the LOAD RESUME option. If you want the RESUME option to apply to a particular partition, specify it by using PART *integer* RESUME.

NO Loads records into an empty partition. If the partition is not empty, and you have not used REPLACE, a message is issued, and the utility job step terminates with a job step condition code of 8.

For nonsegmented table spaces that contains deleted rows or rows of dropped tables, using the REPLACE keyword provides increased efficiency.

YES
Loads records into a non-empty partition. If the partition is empty, a warning message is issued, but the partition is loaded.

REPLACE
Indicates that you want to replace only the contents of the partition that is cited by the PART option, rather than the entire table space.

You cannot use LOAD REPLACE with the PART *integer* REPLACE option of INTO TABLE. If you specify the REPLACE option, you must either replace an entire table space, using LOAD REPLACE, or a single partition, using the PART *integer* REPLACE option of INTO TABLE. You can, however, use PART *integer* REPLACE with LOAD RESUME YES.

REUSE
Specifies, when used with the REPLACE option, that LOAD should logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE, DB2 deletes and redefines DB2-managed data sets to reset them.

If you specify REUSE with REPLACE on the PART specification (and not for LOAD at the table space level), only the specified partitions are logically reset. If you specify REUSE for the table space and REPLACE for the partition, data sets for the replaced parts are logically reset.

KEEPDICTIONARY
Specifies that the LOAD utility is not to build a new dictionary. LOAD retains the current dictionary and uses it for compressing the input data. This option eliminates the cost that is associated with building a new dictionary.

This keyword is valid only if a dictionary exists and the partition that is being loaded has the COMPRESS YES attribute.

If the partition has the COMPRESS YES attribute, but no dictionary exists, one is built and an error message is issued.

INDDN *ddname*
Specifies the data definition (DD) statement or template that identifies the input data set for the partition. The record format for the input data set must be fixed or variable. The data set must be readable by the basic sequential access method (BSAM).

The *ddname* is the name of the input data set.

The default value is **SYSREC**. INDDN can be a template name.

When loading LOB data using file reference variables, this input data set should include the names of the files that contain the LOB column values. Each file can be either a sequential file, PDS member, PDSE member, or separate HFS file.

If you specify INDDN, with or without DISCARDDN, in one INTO TABLE PART specification and you supply more than one INTO TABLE PART clause, you must specify INDDN in all INTO TABLE PART specifications.

Specifying INDDN at the partition level and supplying multiple PART clauses, each with their own INDDN, enables load partition parallelism, which can significantly improve performance. Loading all partitions in a single job with load partition parallelism is recommended instead of concurrent separate jobs whenever one or more nonpartitioned secondary indexes are on the table space.

The field specifications apply separately to each input file. Therefore, if multiple INTO TABLE PART INDDN clauses are used, field specifications are required on each one.

DISCARDDN *ddname*
Specifies the DD statement for a discard data set for the partition. The discard data set holds copies of records that are not loaded (for example, if they contain conversion errors). The discard data set also holds copies of records that were loaded and then removed (due to unique index errors, or referential or check constraint violations).

Flag input records for discarding during the RELOAD, INDEXVAL, and ENFORCE phases. However, the utility does not write the discard data set until the DISCARD phase when the utility copies the flagged records from the input data set to the discard data set.

The discard data set must be a sequential data set, and it must be write-accessible by BSAM, with the same record format, record length, and block size as the input data set.

The *ddname* is the name of the discard data set. DISCARDDN can be a template name.

If you omit the DISCARDDN option, LOAD does not save discarded records.

INCURSOR *cursor-name*
Specifies the cursor for the input data set. You must declare the cursor before it is used by the LOAD utility. Use the EXEC SQL utility control statement to define the cursor. You cannot load data into the same table on which you defined the cursor.

The specified cursor can be used as part of the DB2 family cross loader function, which enables you to load data from any DRDA-compliant remote

server. For more information about using the cross loader function, see "Loading data by using the cross-loader function" on page 331.

cursor-name is the cursor name. Cursor names that are specified with the LOAD utility cannot be longer than eight characters.

You cannot use the INCURSOR option with the following options:
- SHRLEVEL CHANGE
- NOSUBS
- FORMAT UNLOAD
- FORMAT SQL/DS
- CONTINUEIF
- WHEN
- SPANNED YES

In addition, you cannot specify field specifications with the INCURSOR option.

WHEN
Indicates which records in the input data set are to be loaded. If no WHEN clause is specified (and if FORMAT UNLOAD was not used in the LOAD statement), **all** records in the input data set are loaded into the specified tables or partitions. (Data that is beyond the range of the specified partition is not loaded.)

The option following WHEN describes a condition; input records that satisfy the condition are loaded. Input records that do not satisfy any WHEN clause of any INTO TABLE statement are written to the discard data set, if one is being used.

Character-string constants should be specified in LOAD utility control statements in the character set that matches the input data record. Specify EBCDIC constants in the LOAD control statement if your data is in EBCDIC and specify UNICODE constants if your data is in UNICODE. You may also code the WHEN condition using the hexadecimal form. For example, use `(1:1)=X'31'` rather than `(1:1)='1'`.

SQL/DS='*table-name***'**
Is valid only when the FORMAT SQL/DS option is used on the LOAD statement.

table-name is the name of a table that has been unloaded into the unload data set. The table name after INTO TABLE tells which DB2 table the SQL/DS table is loaded into. Enclose the table name in quotation marks if the name contains a blank.

If no WHEN clause is specified, input records from every SQL/DS table are loaded into the table that is specified after INTO TABLE.

field-selection-criterion
Describes a field and a character constant. Only those records in which the field contains the specified constant are to be loaded into the table that is specified after INTO TABLE.

A field in a selection criterion must:
- Contain a character or graphic string. No data type conversions are performed when the contents of the field in the input record are compared to a string constant.
- Start at the same byte offset in each assembled input record. If any record contains varying-length strings, which are stored with length fields, that **precede** the selection field, they must be padded so that the start of the selection field is always at the same offset.

The field and the constant do not need to be the same length. If they are not, the shorter of the two is padded before a comparison is made. Character and graphic strings are padded with blanks. Hexadecimal strings are padded with zeros.

field-name
Specifies the name of a field that is defined by a *field-specification*. If *field-name* is used, the start and end positions of the field are given by the POSITION option of the field specification.

(start:end)
Identifies column numbers in the assembled load record; the first column of the record is column 1. The two numbers indicate the starting and ending columns of a selection field in the load record.

If *:end* is not used, the field is assumed to have the same length as the constant.

X'*byte-string***'**
Identifies the constant as a string of hexadecimal characters. For example, the following WHEN clause specifies that a record is to be loaded if it has the value X'FFFF' in columns 33 through 34.

```
WHEN (33:34) = X'FFFF'
```

'*character-string***'**
Identifies the constant as a string of characters. For example, the following WHEN clause specifies that a record is to be loaded if the field DEPTNO has the value D11.

```
WHEN DEPTNO = 'D11'
```

G'*graphic-string***'**
Identifies the constant as a string of double-byte characters. For example, the following WHEN clause specifies that a record is to be loaded if it has the specified value in columns 33 through 36.

```
WHEN (33:36) = G'<**>'
```

In this example, < is the shift-out character,* is a double-byte character, and > is the shift-in character.

If the first or last byte of the input data is a shift-out character, it is ignored in the comparison. Specify G as an uppercase character.

N'*graphic-string***'**
Identifies the constant as a string of double-byte characters. N and G are synonymous for specifying graphic string constants. Specify N as an uppercase character.

(*field-specification***, ...)**
Describes the location, format, and null value identifier of the data that is to be loaded.

If no field specifications are used:

- The fields in the input records are assumed to be in the same order as in the DB2 table.
- The formats are set by the FORMAT option on the LOAD statement, if that option is used.
- Fixed strings in the input are assumed to be of fixed maximum length. VARCHAR and VARGRAPHIC fields must contain a valid 2-byte binary

length field preceding the data; no intervening gaps are allowed between the VARCHAR or VARGRAPHIC fields and the field that follows.

- BINARY fields are assumed to be of fixed maximum length.
- VARBINARY fields must contain a valid 2-byte binary length field preceding the data.
- ROWID fields are varying length, and must contain a valid 2-byte binary length field preceding the data; no intervening gaps are allowed between ROWID fields and the fields that follow.
- LOB fields are varying length, and require a valid 4-byte binary length field preceding the data; no intervening gaps are allowed between them and the LOB fields that follow.
- Numeric data is assumed to be in the appropriate internal DB2 number representation.
- The NULLIF or DEFAULTIF options cannot be used.

If any field specification is used for an input table, a field specification must exist for each field of the table that does not have a default value. Any field in the table with no corresponding field specification is loaded with its default value.

If any column in the output table does not have a field specification and is defined as NOT NULL, with no default, the utility job step is terminated.

Identity columns or row change timestamp columns can appear in the field specification only if you defined them with the GENERATED BY DEFAULT attribute.

If you are loading application or system temporal data and you include field specifications, you must specify both the start and end time column fields.

field-name
Specifies the name of a field, which can be a name of your choice. If the field is to be loaded, the name must be the name of a column in the table that is named after INTO TABLE unless IGNOREFIELDS is specified. You can use the field name as a vehicle to specify the range of incoming data. See Example 4: Loading data of different data types for an example of loading selected records into an empty table space.

The starting location of the field is given by the POSITION option. If POSITION is not used, the starting location is one column after the end of the previous field.

LOAD determines the length of the field in one of the following ways, in the order listed:

1. If the field has data type VARCHAR, VARGRAPHIC, VARBINARY, ROWID, or XML the length is assumed to be contained in a 2-byte binary field that precedes the data. For VARCHAR, VARBINARY, and XML fields, the length is in bytes; for VARGRAPHIC fields, the length field identifies the number of double-byte characters.

   If the field has data type CLOB, BLOB, or DBCLOB, the length is assumed to be contained in a 4-byte binary field that precedes the data. For BLOB and CLOB fields, the length is in bytes; for DBCLOB fields, the length field identifies the number of double-byte characters.
2. If *:end* is used in the POSITION option, the length is calculated from *start* and *end*. In that case, any length attribute after the CHAR, GRAPHIC, INTEGER, DECIMAL, FLOAT, or DECFLOAT specifications is ignored.

3. The length attribute on the CHAR, GRAPHIC, INTEGER, DECIMAL, FLOAT, or DECFLOAT specifications is used as the length.
4. The length is taken from the DB2 field description in the table definition, or it is assigned a default value according to the data type. For DATE and TIME fields, the length is defined during installation. For variable-length fields, the length is defined from the column in the DB2 table definition, excluding the null indicator byte, if it is present. The following table shows the default length, in bytes, for each data type.

Table 33. Default length of each data type (in bytes)

Data type	Default length in bytes
BIGINT	8
BINARY	Length that is used in column definition
BLOB	Varying
CHARACTER	Length that is used in column definition
CLOB	Varying
DATE	10 (or installation default)
DBCLOB	Varying
DECFLOAT(16)	8
DECFLOAT(34)	16
DECIMAL EXTERNAL	Decimal precision for output columns that are decimal, otherwise the length that is used in column definition
DECIMAL PACKED	Length that is used in column definition
DECIMAL ZONED	Decimal precision for output columns that are decimal, otherwise the length that is used in column definition
FLOAT (single precision)	4
FLOAT (double precision)	8
GRAPHIC	2 multiplied by (length that is used in column definition)
INTEGER	4
MIXED	Mixed DBCS data
ROWID	Varying
SMALLINT	2
TIME	8 (or installation default)
TIMESTAMP	26
VARBINARY	Varying
VARCHAR	Varying
VARGRAPHIC	Varying
XML	Varying
TIMESTAMP WITH TIME ZONE	33

If a data type is not given for a field, its data type is assumed to be the same as that of the column into which it is loaded, as given in the DB2 table definition.

POSITION(*start:end*)

Indicates where a field is in the assembled load record.

start and *end* are the locations of the first and last columns of the field; the first column of the record is column 1. The option can be omitted.

Column locations can be specified as:

- An integer *n*, meaning an actual column number
- *, meaning one column after the end of the previous field
- *+*n*, where *n* is an integer, meaning *n* columns after the location that is specified by *

Do not enclose the entire POSITION option specification in parentheses; enclose only the *start:end* description in parentheses. Valid and invalid specifications are shown in the following table.

Table 34. Example of valid and invalid POSITION specifications

Valid	Invalid
`POSITION (10:20)`	`(POSITION (10:20))`

Data types in a field specification: The data type of the field can be specified by any of the keywords that follow. Except for graphic fields, *length* is the length in bytes of the input field.

All numbers that are designated EXTERNAL are in the same format in the input records.

CHAR(*length*)

Specifies a fixed-length character string. If you do not specify*length*, the length of the string is determined from the POSITION specification. If you do not specify*length* or POSITION, LOAD uses the default length for CHAR, which is determined from the length of the column in the table. You can also specify CHARACTER and CHARACTER(*length*).

When you specify CHAR as the type for the file name for CLOBF, BLOBF, or DBCLOBF, you must also provide the length so that the LOAD utility can determine the correct file name. Otherwise message DSNU338I will be issued for an invalid column specification.

BIT

Specifies that the input field contains BIT data. If BIT is specified, LOAD bypasses any CCSID conversions for the input data. If the target column has the BIT data type attribute, LOAD bypasses any code page translation for the input data.

MIXED

Specifies that the input field contains mixed SBCS and DBCS data. If MIXED is specified, any required CCSID conversions use the mixed CCSID for the input data. If MIXED is not specified, any such conversions use the SBCS CCSID for the input data.

BLOBF

Indicates that the input field contains the name of a BLOB file which is going to be loaded to a specified BLOB/XML column.

BINARYXML Specifies that the XML document to be loaded using file reference variables is in Extensible Dynamic Binary XML DB2 Client/Server Binary XML Format (binary XML) format.

CLOBF
Indicates that the input field contains the name of a CLOB file which is going to be loaded to a specified CLOB/XML column.

DBCLOBF
Indicates that the input field contains the name of a DBCLOBF file which is going to be loaded to a specified DBCLOB/XML column.

PRESERVE WHITESPACE
Specifies that the white space in the XML column is preserved. The default is not to preserve the white space.

STRIP
Specifies that LOAD is to remove zeros (the default) or the specified characters from the beginning, the end, or both ends of the data. LOAD pads the CHAR field, so that it fills the rest of the column.

LOAD applies the strip operation before performing any character code conversion or padding.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

'strip-char'
Specifies a single-byte or double-byte character that LOAD is to strip from the data.

Specify this character value in EBCDIC. Depending on the input encoding scheme, LOAD applies SBCS CCSID conversion to the *strip-char* value before it is used in the strip operation.

If the subtype of the column to be loaded is BIT or you want to specify a *strip-char* value in an encoding scheme other than EBCDIC, use the hexadecimal form (*X'strip-char'*). LOAD does not perform any CCSID conversion if the hexadecimal form is used.

X'strip-char'
Specifies in hexadecimal form a single-byte or double-byte character that LOAD is to strip from the data. For single-byte characters, specify this value in the form X'hh', where *hh* is two hexadecimal characters. For double-byte characters, specify this value in the form X'hhhh', where *hhhh* is four hexadecimal characters.

Use the hexadecimal form to specify a character in an encoding scheme other than EBCDIC. When you specify the character value in hexadecimal form, LOAD does not perform any CCSID conversion.

If you specify a strip character in the hexadecimal format, you must specify the character in the input encoding scheme.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column. LOAD performs the truncation operation after any CCSID translation.

If the input data is BIT data, LOAD truncates the data at a byte boundary. If the input data is SBCS or MIXED data, LOAD truncates the data at a character boundary. (Double-byte characters are not split.) If a MIXED field is truncated to fit a column, the truncated string can be shorter than the specified column size. In this case, blanks in the output CCSID are padded to the right. If MIXED data is in EBCDIC, truncation preserves the SO (shift-out) and SI (shift-in) characters around a DBCS string.

VARCHAR
Specifies a character field of varying length. The length in bytes must be specified in a 2-byte binary field preceding the data. (The length does not include the 2-byte field itself.) The length field must start in the column that is specified as *start* in the POSITION option. If *:end* is used, it is ignored.

BIT
Specifies that the input field contains BIT data. If BIT is specified, LOAD bypasses any CCSID conversions for the input data. If the target column has the BIT data type attribute, LOAD bypasses any code page translation for the input data.

MIXED
Specifies that the input field contains mixed DBCS data. If MIXED is specified, any required CCSID conversions use the mixed CCSID for the input data. If MIXED is not specified, any such conversions use the SBCS CCSID for the input data.

BLOBF
Indicates that the input field contains the name of a BLOB file which is going to be loaded to a specified BLOB/XML column.

BINARYXML Specifies that the XML document to be loaded using file reference variables is in binary XML format.

CLOBF
Indicates that the input field contains the name of a CLOB file which is going to be loaded to a specified CLOB/XML column.

DBCLOBF
Indicates that the input field contains the name of a DBCLOBF file which is going to be loaded to a specified DBCLOB/XML column.

PRESERVE WHITESPACE
Specifies that the white space in the XML column is preserved. The default is not to preserve the white space.

STRIP
Specifies that LOAD is to remove zeros (the default) or the specified characters from the beginning, the end, or both ends of the data. LOAD adjusts the VARCHAR length field to the length of the stripped data.

LOAD applies the strip operation before performing any character code conversion or padding.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

'strip-char'
Specifies a single-byte or double-byte character that LOAD is to strip from the data.

Specify this character value in EBCDIC. Depending on the input encoding scheme, LOAD applies SBCS CCSID conversion to the *strip-char*value before it is used in the strip operation.

If the subtype of the column to be loaded is BIT or you want to specify a *strip-char* value in an encoding scheme other than EBCDIC, use the hexadecimal form (*X'strip-char'*). LOAD does not perform any CCSID conversion if the hexadecimal form is used.

X'strip-char'
Specifies in hexadecimal form a single-byte or double-byte character that LOAD is to strip from the data. For single-byte characters, specify this value in the form X'hh', where *hh* is two hexadecimal characters. For double-byte characters, specify this value in the form X'hhhh', where *hhhh* is four hexadecimal characters.

Use the hexadecimal form to specify a character in an encoding scheme other than EBCDIC. When you specify the character value in hexadecimal form, LOAD does not perform any CCSID conversion.

If you specify a strip character in the hexadecimal format, you must specify the character in the input encoding scheme.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column. LOAD performs the truncation operation after any CCSID translation.

If the input data is BIT data, LOAD truncates the data at a byte boundary. If the input data is character type data, LOAD truncates the data at a character boundary. If a mixed-character type data is truncated to fit a column of fixed size, the truncated string can be shorter than the specified column size. In this case, blanks in the output CCSID are padded to the right.

GRAPHIC(*length***)**
Specifies a fixed-length graphic type. You can specify both *start* and *end* for the field specification.

If you use GRAPHIC, the input data must not contain shift characters. *start* and *end* must indicate the starting and ending positions of the data itself.

length is the number of double-byte characters. The length of the field in bytes is twice the value of *length*. If you do not specify *length*, the number of double-byte characters is determined from the POSITION specification. If you

do not specify *length* or POSITION, LOAD uses the default length for GRAPHIC, which is determined from the length of the column in the table.

For example, let *** represent three double-byte characters. Then, to describe ***, specify either `POS(1:6) GRAPHIC` or `POS(1) GRAPHIC(3)`. A GRAPHIC field that is described in this way cannot be specified in a field selection criterion.

STRIP
Specifies that LOAD is to remove zeros (the default) or the specified characters from the beginning, the end, or both ends of the data.

LOAD applies the strip operation before performing any character code conversion or padding.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

X'strip-char'
Specifies the hexadecimal form of the double-byte character that LOAD is to strip from the data. Specify this value in the form X'hhhh', where *hhhh* is four hexadecimal characters.

You must specify the character in the input encoding scheme.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column. LOAD performs the truncation operation after any CCSID translation.

LOAD truncates the data at a character boundary. Double-byte characters are not split.

GRAPHIC EXTERNAL(*length*)
Specifies a fixed-length field of the graphic type with the external format. You can specify both *start* and *end* for the field specification.

If you use GRAPHIC EXTERNAL, the input data must contain a shift-out character in the starting position, and a shift-in character in the ending position. Other than the shift characters, this field must have an even number of bytes. The first byte of any pair must not be a shift character.

length is the number of double-byte characters. *length* for GRAPHIC EXTERNAL does not include the number of bytes that are represented by shift characters. The length of the field in bytes is twice the value of *length*. If you do not specify *length*, the number of double-byte characters is determined from the POSITION specification. If you do not specify *length* or POSITION, LOAD uses the default length for GRAPHIC, which is determined from the length of the column in the table.

For example, let *** represent three double-byte characters, and let < and > represent shift-out and shift-in characters. Then, to describe <***>, specify either `POS(1:8) GRAPHIC EXTERNAL` or `POS(1) GRAPHIC EXTERNAL(3)`.

STRIP
Specifies that LOAD is to remove zeros (the default) or the specified characters from the beginning, the end, or both ends of the data.

LOAD applies the strip operation before performing any character code conversion or padding.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

X'strip-char'
Specifies the hexadecimal form of the double-byte character that LOAD is to strip from the data. Specify this value in the form X'hhhh', where *hhhh* is four hexadecimal characters.

You must specify the character in the input encoding scheme.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column. LOAD performs the truncation operation after any CCSID translation.

LOAD truncates the data at a character boundary. Double-byte characters are not split.

VARGRAPHIC
Identifies a graphic field of varying length. The length, in double-byte characters, must be specified in a 2-byte binary field preceding the data. (The length does not include the 2-byte field itself.) The length field must start in the column that is specified as *start* in the POSITION option. *:end*, if used, is ignored.

VARGRAPHIC input data must not contain shift characters.

STRIP
Specifies that LOAD is to remove zeros (the default) or the specified characters from the beginning, the end, or both ends of the data. LOAD adjusts the VARGRAPHIC length field to the length of the stripped data (the number of DBCS characters).

LOAD applies the strip operation before performing any character code conversion or padding.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

X'strip-char'
Specifies the hexadecimal form of the double-byte character that LOAD is to strip from the data. Specify this value in the form X'hhhh', where *hhhh* is four hexadecimal characters.

You must specify the character in the input encoding scheme.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column. LOAD performs the truncation operation after any CCSID translation.

LOAD truncates the data at a character boundary. Double-byte characters are not split.

SMALLINT
Specifies a 2-byte binary number. Negative numbers are in two's complement notation.

INTEGER
Specifies a 4-byte binary number. Negative numbers are in two's complement notation. You can also specify INT.

INTEGER EXTERNAL(*length***)**
A string of characters that represent a number. The format is that of an SQL numeric constant. If you do not specify *length*, the length of the string is determined from the POSITION specification. If you do not specify *length* or POSITION, LOAD uses the default length for INTEGER, which is 4 bytes. You can also specify INT EXTERNAL.

BIGINT
Specifies an 8-byte binary number. Negative numbers are in two's complement notation.

BINARY(*length***)**
Specifies a fixed-length binary string. If you do not specify *length*, the length of the string is determined from the POSITION specification. If you do not specify *length* or POSITION, LOAD uses the default length for BINARY, which is determined from the length of the column in the table. The default for *X'strip-char'* is hexadecimal zero (X'00'). No data conversion is applied to the field.

STRIP
Specifies that LOAD is to remove binary zeros (the default) or the specified *X'strip-char'* from the beginning, the end, or both ends of the data. LOAD pads the BINARY field, so that it fills the rest of the column.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of binary zeros or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

X'strip-char'
Specifies, in hexadecimal form, a single-byte or double-byte character that LOAD is to strip from the data. For single-byte characters, specify this value in the form X'hh', where *hh* is two hexadecimal characters.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column.

LOAD truncates the data at a character boundary.

VARBINARY
Specifies a varying length binary string. The length in bytes must be specified in a 2-byte binary field preceding the data (the length does not include the 2-byte field itself). The length field must start in the column that is specified as start in the POSITION option. If *:end* is used, it is ignored. The default for *X'strip-char'* is hexadecimal zero (X'00'). No data conversion is applied to the field.

STRIP
Specifies that LOAD is to remove binary zeros (the default) or the specified characters from the beginning, the end, or both ends of the data. LOAD pads the VARBINARY field, so that it fills the rest of the column.

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that LOAD is to remove occurrences of binary zeros or the specified strip character from the beginning and end of the data.

TRAILING
Indicates that LOAD is to remove occurrences of binary zeros or the specified strip character from the end of the data.

LEADING
Indicates that LOAD is to remove occurrences of binary zeros or the specified strip character from the beginning of the data.

X'strip-char'
Specifies, in hexadecimal form, a single-byte character that LOAD is to strip from the data. For single-byte characters, specify this value in the form X'hh', where *hh* is two hexadecimal characters.

TRUNCATE
Indicates that LOAD is to truncate the input character string from the right if the string does not fit in the target column.

LOAD truncates the data at a character boundary.

DECIMAL PACKED
Specifies a number of the form *ddd...ds*, where *d* is a decimal digit that is represented by four bits, and *s* is a 4-bit sign value. The plus sign (+) is represented by A, C, E, or F, and the minus sign (-) is represented by B or D. The maximum number of *d*s is the same as the maximum number of digits that are allowed in the SQL definition. You can also specify DECIMAL, DEC, or DEC PACKED.

DECIMAL ZONED
Specifies a number in the form *znznzn...z/sn*, where *z*, *n*, and *s* have the following values:

n A decimal digit represented by the right 4 bits of a byte (called the *numeric bits*)

z That digit's zone, represented by the left 4 bits

s The right-most byte of the decimal operand; *s* can be treated as a zone or as the sign value for that digit

The plus sign (+) is represented by A, C, E, or F, and the minus sign (-) is represented by B or D. The maximum number of *zn*s is the same as the maximum number of digits that are allowed in the SQL definition. You can also specify DEC ZONED.

DECIMAL EXTERNAL(*length*,*scale*)
Specifies a string of characters that represent a number. The format is that of an SQL numeric constant.

length
Overall length of the input field, in bytes. If you do not specify *length*, the length of the input field is determined from the POSITION specification. If you do not specify *length* or POSITION, LOAD uses the default length for DECIMAL EXTERNAL, which is determined by using decimal precision.

scale
Specifies the number of digits to the right of the decimal point. *scale* must be an integer greater than or equal to 0, and it can be greater than *length*. The **default** value is **0**.

If *scale* is greater than *length*, or if the number of provided digits is less than the *specified scale*, the input number is padded on the left with zeros until the decimal point position is reached. If *scale* is greater than the target *scale*, the source scale locates the implied decimal position. All fractional digits greater than the target scale are truncated. If scale is specified and the target column has a data type of small integer or integer, the decimal portion of the input number is ignored. If a decimal point is present, its position overrides the field specification of *scale*.

FLOAT(*length*)
Specifies either a 64-bit floating-point number or a 32-bit floating-point number. If *length* is between 1 and 21 inclusive, the number is 32 bits in the s390 (HFP) format:

Bit 0 Represents a sign (0 for plus and 1 for minus)

Bits 1-7
Represent an exponent

Bits 8-31
Represent a mantissa

If *length* is between 1 and 24 inclusive, the number is 32 bits in the IEEE (BFP) format:

Bit 0 Represents a sign (0 for plus and 1 for minus)

Bits 1-8
Represent an exponent

Bits 9-31
Represent a mantissa

If *length* is not specified, or is between 22 and 53 inclusive, the number is 64 bits in the s390 (HFP) format:

Bit 0 Represents a sign (0 for plus and 1 for minus)

Bits 1-7
Represent an exponent

Bits 8-63
Represent a mantissa.

If *length* is not specified, or is between 25 and 53 inclusive, the number is 64 bits in the IEEE (BFP) format:

Bit 0 Represents a sign (0 for "plus", and 1 for "minus")

Bits 1-11
Represent an exponent

Bits 12-63
Represent a mantissa.

You can also specify REAL for single-precision floating-point numbers and DOUBLE PRECISION for double-precision floating-point numbers.

FLOAT EXTERNAL(*length*)
Specifies a string of characters that represent a number. The format is that of an SQL floating-point constant.

A specification of FLOAT(IEEE) or FLOAT(S390) does not apply for this format (string of characters) of floating-point numbers.

If you do not specify *length*, the length of the string is determined from the POSITION specification. If you do not specify *length* or POSITION, LOAD uses the default length for FLOAT, which is 4 bytes for single precision and 8 bytes for double precision.

DATE EXTERNAL(*length*)
Specifies a character string representation of a date. The length, if unspecified, is the specified length on the LOCAL DATA LENGTH installation option, or, if none was provided, the default is 10 bytes. If you specify a length, it must be within the range of 8 to 254 bytes.

Dates can be in any of the following formats. You can omit leading zeros for month and day. You can include trailing blanks, but no leading blanks are allowed.
- *dd.mm.yyyy*
- *mm/dd/yyyy*
- *yyyy-mm-dd*
- Any local format that your site defined at the time DB2 was installed

TIME EXTERNAL(*length*)
Specifies a character string representation of a time. The length, if unspecified,

is the specified length on the LOCAL TIME LENGTH installation option, or, if none was provided, the default is 8 bytes. If you specify a length, it must be within the range of 4 to 254 bytes.

Times can be in any of the following formats:
- *hh.mm.ss*
- *hh:mm* AM
- *hh:mm* PM
- *hh:mm:ss*
- Any local format that your site defined at the time DB2 was installed

You can omit the *mm* portion of the *hh:mm* AM and *hh:mm* PM formats if *mm* is equal to 00. For example, 5 PM is a valid time, and can be used instead of 5:00 PM.

TIMESTAMP EXTERNAL(*length***)**
Specifies a character string representation of a time. The default for *length* is 26 bytes. If you specify a length, it must be within the range of 19 to 32 bytes.

Timestamps can be in any of the following formats. Note that *nnnnnn* represents the number of microseconds, and can be from 0 to 12 digits. You can omit leading zeros from the month, day, or hour parts of the timestamp; you can omit trailing zeros from the microseconds part of the timestamp.
- *yyyy-mm-dd-hh.mm.ss*
- *yyyy-mm-dd-hh.mm.ss.nnnnnn*
- *yyyy-mm-dd hh:mm:ss.nnnnnn*

TIMESTAMP WITH TIME ZONE EXTERNAL(*length***)**
Specifies a character string representation of a timestamp with time zone. The default for *length* is 33 bytes. If you specify a length, it must be within the range of 26 to 39 bytes.

Timestamp with time zone can be in any of the following formats. Note that *nnnnnn* represents the number of digits in the fractional seconds, and can be from 0 to 12 digits. You can omit leading zeros from the month, day, or hour parts of the timestamp; you can omit trailing zeros from the fractional seconds part of the timestamp.
- *yyyy-mm-dd-hh.mm.ss.nnnnnn±th:tm*
- *yyyy-mm-dd-hh.mm.ss.nnnnnn ±th:tm*
- *yyyy-mm-dd hh:mm:ss.nnnnnn±th:tm*
- *yyyy-mm-dd hh:mm:ss.nnnnnn ±th:tm*

ROWID
Specifies a row ID. The input data must be a valid value for a row ID; DB2 does not perform any conversions.

A field specification for a row ID column is not allowed if the row ID column was created with the GENERATED ALWAYS option.

If the row ID column is part of the partitioning key, LOAD INTO TABLE PART is not allowed; specify LOAD INTO TABLE instead.

BLOB
Specifies a BLOB field. You must specify the length in bytes in a 4-byte binary field that precedes the data. (The length does **not** include the 4-byte field itself.) The length field must start in the column that is specified as *start* in the POSITION option. If *:end* is used, it is ignored.

CLOB
Specifies a CLOB field. You must specify the length in bytes in a 4-byte binary field that precedes the data. (The length does **not** include the 4-byte field

itself.) The length field must start in the column that is specified as *start* in the POSITION option. If *:end* is used, it is ignored.

MIXED
Specifies that the input field contains mixed SBCS and DBCS data. If MIXED is specified, any required CCSID conversions use the mixed CCSID for the input data; if MIXED is not specified, any such conversions use the SBCS CCSID for the input data.

DBCLOB
Specifies a DBCLOB field. You must specify the length in double-byte characters in a 4-byte binary field that precedes the data. (The length does **not** include the 4-byte field itself.) The length field must start in the column that is specified as *start* in the POSITION option. If *:end* is used, it is ignored.

DECFLOAT *(length)*
Specifies either a 128-bit decimal floating-point number or a 64-bit decimal floating-point number. The value of the length must be either 16 or 34. If the length is 16, the number is in 64 bit decimal floating-point number format. If the length is 34, the number is in 128 bit decimal floating-point format. If the length is not specified, the number is in 128 bit decimal floating-point format.

DECFLOAT EXTERNAL *(length)*
Specifies a string of characters that represent a number. The format is an SQL numeric constant. If you do not specify a length, the length of the string is determined from the POSITION specification. If you do not specify a length or POSITION, LOAD uses the default length for DECFLOAT.

XML
Specifies the input field type is XML. Field type XML can only be loaded to a XML column. Specify XML when loading the XML value directly from the input record. If the format of the input record is in nondelimited, you must specify a 2 byte length field precedes the actual data value.

BINARYXML Specifies that the XML document to be loaded using the file reference variables is in binary XML format.

PRESERVE WHITESPACE
Specifies that the white space in the XML column is preserved. The default is not to preserve the white space.

DEFAULTIF *field-selection-criterion*
Describes a condition that causes the DB2 column to be loaded with its default value. You can write the *field-selection-criterion* with the same options as described under field-selection-criterion. If the contents of the DEFAULTIF field match the provided character constant, the field that is specified in *field-specification* is loaded with its default value.

If the DEFAULTIF field is defined by the name of a VARCHAR or VARGRAPHIC field, DB2 takes the length of the field from the 2-byte binary field that appears before the data portion of the VARCHAR or VARGRAPHIC field.

Character-string constants should be specified in LOAD utility control statements in the character set that matches the input data record. Specify EBCDIC constants in the LOAD control statement if your data is in EBCDIC and specify UNICODE constants if your data is in UNICODE. You may also code the DEFAULTIF condition using the hexadecimal form. For example, if the input data is in EBCDIC and the control statement is in UTF-8, use `(1:1)=X'31'` in the condition rather than `(1:1)='1'`.

You can use the DEFAULTIF attribute with the ROWID keyword. If the condition is met, the column is loaded with a value that DB2 generates.

You cannot specify the DEFAULTIF option for XML columns.

NULLIF *field-selection-criterion*

Describes a condition that causes the DB2 column to be loaded with NULL. You can write the *field-selection-criterion* with the same options as described under field-selection-criterion. If the contents of the NULLIF field match the provided character constant, the field that is specified in *field-specification* is loaded with NULL.

If the NULLIF field is defined by the name of a VARCHAR or VARGRAPHIC field, DB2 takes the length of the field from the 2-byte binary field that appears before the data portion of the VARCHAR or VARGRAPHIC field.

To load a null value into a BLOBF, CLOBF, or DBCLOBF field, use a null input file name.

Character-string constants should be specified in LOAD utility control statements in the character set that matches the input data record. Specify EBCDIC constants in the LOAD control statement if your data is in EBCDIC and specify UNICODE constants if your data is in UNICODE. You may also code the NULLIF condition using the hexadecimal form. For example, if the input data is in EBCDIC and the control statement is in UTF-8, use `(1:1)=X'31'` in the condition rather than `(1:1)='1'`.

The fact that a field in the output table is loaded with NULL does not change the format or function of the corresponding field in the input record. The input field can still be used in a field selection criterion. For example, assume that a LOAD statement has the following field specification:

```
(FIELD1 POSITION(*) CHAR(4)
 FIELD2 POSITION(*) CHAR(3) NULLIF(FIELD1='SKIP')
 FIELD3 POSITION(*) CHAR(5))
```

Assume also that LOAD is to process the following source record:

```
SKIP   FLD03
```

In this example, the record is loaded as follows:

FIELD1
Has the value 'SKIP'.

FIELD2
Is NULL (not ' ' as in the source record).

FIELD3
Has the value 'FLD03'.

You cannot use the NULLIF parameter with the ROWID keyword because row ID columns cannot be null.

Field selection criterion

Describes a condition that causes the DB2 column to be loaded with NULL or with its default value.

Related concepts:

Constants (DB2 SQL)

Related tasks:

"Preparing DB2 internal format input records that are not generated by UNLOAD for LOAD" on page 312

Related reference:

STRIP (DB2 SQL)

EDITPROCs and VALIDPROCs for handling basic and reordered row formats (DB2 Administration Guide)

Chapter 35, "TEMPLATE," on page 789

DB2 Sort

Related information:

Converting basic row format table spaces with edit and validation routines to reordered row format (DB2 Administration Guide)

DFSORT Application Programming Guide

Before running LOAD

Certain activities might be required before you run the LOAD utility, depending on your situation.

You cannot run the LOAD utility on the DSNDB01 or DSNDB06 databases, except to add rows to the following catalog tables:

- SYSSTRINGS
- MODESELECT
- LUMODES
- LULIST
- USERNAMES
- LUNAMES
- LOCATIONS
- IPNAMES

If you are using LOAD for a partition-by-growth table space, you can load data only at the table space level, not at the partition level.

Preprocessing input data

No sorting of the data rows occurs during LOAD processing. Rows are loaded in the physical sequence in which they are found.

Recommendation: Sort your input records in clustering sequence before loading the data.

You should also:

- Ensure that no duplicate keys exist for unique indexes.
- Correct check constraint violations and referential constraint violations in the input data set.
- Ensure that any input data that is provided for a security label column is a valid security label. Security label columns are defined with the AS SECURITY LABEL clause. These columns are used for multilevel security with row-level granularity.

When loading data into a segmented table space, sort your data by table to ensure that the data is loaded in the best physical organization.

Loading data by using a cursor

Before you can load data by using a cursor, you need to bind the DSNUT111 package at each location from which you plan to load data. A local package for DSNUT111 is bound by installation job DSNTIJSG when you install or migrate to a new version of DB2 for z/OS.

The following example statement binds the DSNUT111 package at a remote location:

```
BIND PACKAGE(location.DSNUT111)
         MEMBER(DSNUGSQL) -
         ACTION(ADD) ISOLATION(CS) ENCODING(EBCDIC) -
         VALIDATE(BIND) CURRENTDATA(NO) -
         LIBRARY('prefix.SDSNDBRM')
```

You can improve the performance of cross-loading from a remote DB2 for z/OS Version 11 subsystem in new-function mode to a local DB2 for z/OS Version 11 subsystem in new-function mode by binding the DSNUTIL and DSNUT111 packages again on the local and remote subsystems after you have converted to new-function mode.

The following example statements bind the DSNUTIL and DSNUT111 packages on the local subsystem, and binds the DSNUT111 package on the remote subsystem:

```
BIND PACKAGE(DSNUTIL) MEMBER(DSNUGSQL) -
         ACTION(ADD) ISOLATION(CS) ENCODING(EBCDIC) -
         VALIDATE(BIND) CURRENTDATA(NO) -
         DBPROTOCOL(DRDACBF) -
         LIBRARY('prefix.SDSNDBRM')
BIND PACKAGE(DSNUT111) MEMBER(DSNUGSQL) -
         ACTION(ADD) ISOLATION(CS) ENCODING(EBCDIC) -
         VALIDATE(BIND) CURRENTDATA(NO) -
         DBPROTOCOL(DRDACBF) -
         LIBRARY('prefix.SDSNDBRM')
BIND PACKAGE(location.DSNUT111) MEMBER(DSNUGSQL) -
         ACTION(ADD) ISOLATION(CS) ENCODING(EBCDIC) -
         VALIDATE(BIND) CURRENTDATA(NO) -
         DBPROTOCOL(DRDACBF) -
         LIBRARY('prefix.SDSNDBRM')
```

Running LOAD on a table with a spatial index

You cannot run the LOAD utility to load data into a table on which a spatial index is defined. You need to drop the spatial index, run LOAD on the table, and then create the spatial index again.

Related concepts:

Multilevel security (Managing Security)

Data sets that LOAD uses

The LOAD utility uses a number of data sets during its operation.

The following table lists the data sets that LOAD uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set, and any optional data sets that you want to use. Alternatively, you can use the TEMPLATE utility to dynamically allocate some of these data sets.

Table 35. Data sets that LOAD uses

Data set	Description	Required?
RNPRIN*nn*	A data set that contains messages from the sort program (usually SYSOUT or DUMMY). This data set is used when distribution statistics are collected for column groups. *nn* is a number from 01 to the number of parallel subtasks.	No[1]
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
STPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when statistics are collected on at least one data-partitioned secondary index, or when COLGROUP and FREQVAL keywords are specified.	Yes [1, 2, 16]
Input data set	The input data set that contains the data that is to be loaded. Specify its template or DD name with the INDDN option of the utility control statement. The default name is SYSREC. It must be a sequential data set that is readable by BSAM. The input file can be an HFS or zFS file, in which case use a template with the PATH option.	Yes[4, 15]
Sort data sets	Two temporary work data sets for sort input and sort output. Specify their DD or template names with the WORKDDN option of the utility control statement. The default DD name for sort input is SYSUT1. The default DD name for sort output is SORTOUT.	Yes[5, 6, 15]
Mapping data set	Work data set for mapping the identifier of a table row back to the input record that caused an error. Specify its template or DD name with the MAPDDN option of the utility control statement. The default DD name is SYSMAP.	Yes[5,7]
UTPRINT	Contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes
Discard data set	A work data set that contains copies of records that are not loaded. It must be a sequential data set that is readable by BSAM. Specify its DD or template name with the DISCARDDN option of the utility control statement. The default DD name is SYSDISC.	Yes [9, 15]
Error data set	Work data set for error processing. Specify its DD or template name with the ERRDDN option of the utility control statement. The default DD or template name is SYSERR.	Yes

Table 35. Data sets that LOAD uses (continued)

Data set	Description	Required?
Copy data sets	One to four output data sets that contain image copy data sets. Specify their DD or template names with the COPYDDN and RECOVERYDDN options of the utility control statement.	No[10]
FlashCopy image copies	For table space or index space level copies, a VSAM data set for the output FlashCopy image copy of each partition or piece. For a partition level or piece level copy, a VSAM data set for the output FlashCopy image copy of the partition or piece.	No[14]
Sort work data sets	Temporary data sets for sort input and output when sorting keys. If index build parallelism is used, the DD names have the form SW*nn*WK*mm*. If index build parallelism is not used, the DD names have the form SORTWK*nn*.	Yes[11,13]
Sort work data sets	Temporary data sets for sort input and output when collecting inline statistics on at least one data-partitioned secondary index, or when the COLGROUP or COLGROUP and FREQVAL options are specified. The DD names have the form ST01WK*nn*.	No[3,12,13]
Sort work data sets	Temporary data sets for sort input and output when collecting distribution statistics for column groups. The DD names have the form RN*mm*WK*nn*, where *mm* is the subtask number, and *nn* is a sequence number for the data set allocated per task.	No[3,12,13]
Sort work data sets	Temporary data sets for sort input and output when collecting frequency statistics. The DD names have the form SORTWK01.	No[12,13]

Table 35. Data sets that LOAD uses (continued)

Data set	Description	Required?

Note:

1. Required when collecting distribution statistics for column groups.
2. STPRIN01 is required if statistics are being collected on at least one data-partitioned secondary index, but LOAD dynamically allocates the STPRIN01 data set if UTPRINT is allocated to SYSOUT.
3. Required when collecting inline statistics on at least one data-partitioned secondary index.
4. As an alternative to specifying an input data set, you can specify a cursor with the INCURSOR option.
5. Required if referential constraints exist and ENFORCE(CONSTRAINTS) is specified (This option is the default).
6. Used for tables with indexes.
7. Required for discard processing when loading one or more tables that have unique indexes.
8. Required if a sort is done.
9. If you omit the DD statement for this data set, LOAD creates the data set with the same record format, record length, and block size as the input data set.
10. Required for inline copies.
11. Required if any indexes are to be built or if a sort is required for processing errors.
12. If the DYNALLOC parm of the SORT program is not turned on, you need to allocate the data set. Otherwise, the sort program dynamically allocates the temporary data set.
13. It is recommended that you use dynamic allocation by specifying SORTDEVT in the utility statement because dynamic allocation reduces the maintenance required of the utility job JCL.
14. Required if you specify either FLASHCOPY YES or FLASHCOPY CONSISTENT.
15. If the SYSREC data set is on tape, and you use templates for the SYSUT1, SYSOUT, or SYSDISC data sets, include the SPACE parameter in the TEMPLATE utility control statements.
16. Required when the COLGROUP and FREQVAL options are specified.

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table Table that is to be loaded. (If you want to load only one partition of a table, you must use the PART option in the control statement.)

Defining work data sets

Use the formulas and instructions in The following table to calculate the size of work data sets for LOAD. Each row in the table lists the DD name that is used to identify the data set and either formulas or instructions that you should use to determine the size of the data set. The key for the formulas is located at the bottom of the table.

Table 36. Size of work data sets for LOAD jobs

Work data set	Size
SORTOUT	*max(f,e)*
ST01WK*nn*	2 ×(*maximum record length* × *numcols* × (*count* + 2) × number of indexes)
SYSDISC	Same size as input data set
SYSERR	*e*

Table 36. Size of work data sets for LOAD jobs (continued)

Work data set	Size
SYSMAP	• Simple table space for discard processing: *m* • Partitioned or segmented table space without discard processing: *max(m,e)*
SYSUT1	• Simple table space: *max(k,e)* • Partitioned or segmented table space: *max(k,e,m)* If you specify an estimate of the number of keys with the SORTKEYS option: *max(f,e)* for a simple table space *max(f,e,m)* for a partitioned or segmented table space

Note:

variable	**meaning**
k	Key calculation
f	Foreign key calculation
m	Map calculation
e	Error calculation
max()	Maximum value of the specified calculations
numcols	Number of key columns to concatenate when you collect frequent values from the specified index
count	Number of frequent values that DB2 is to collect
maximum record length	Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

- **Calculating the key: k**

  If a mix of data-partitioned secondary indexes and nonpartitioned indexes exists on the table that is being loaded or a foreign key exists that is exactly indexed by a data-partitioned secondary index, use this formula:

  *max(longest index key + 15, longest foreign key + 15) * (number of extracted keys)*.

  Otherwise, use this formula:

  *max(longest index key + 13, longest foreign key + 13) * (number of extracted keys)*.

  For nonpadded indexes, the length of the longest key means the maximum possible length of a key with all varying-length columns padded to their maximum lengths, plus 2 bytes for each varying-length column.

- **Calculating the number of extracted keys:**

  1. Count 1 for each index.
  2. Count 1 for each foreign key that is not exactly indexed (that is, where foreign key and index definitions do not correspond identically).
  3. For each foreign key that is exactly indexed (that is, where foreign key and index definitions correspond identically):
     a. Count 0 for the first relationship in which the foreign key participates if the index is not a data-partitioned secondary index. Count 1 if the index is a data-partitioned secondary index.

b. Count 1 for subsequent relationships in which the foreign key participates (if any).

4. Multiply count by the number of rows that are to be loaded.

- **Calculating the foreign key: f**

  If a mix of data-partitioned secondary indexes and nonpartitioned indexes exists on the table that is being loaded or a foreign key exists that is exactly indexed by a data-partitioned secondary index, use this formula:

  *max(longest foreign key + 15) * (number of extracted keys)*

  Otherwise, use this formula:

  *max(longest foreign key + 13) * (number of extracted keys)*

- **Calculating the map: m**

  The data set must be large enough to accommodate one map entry (length = 21 bytes) per table row that is produced by the LOAD job.

- **Calculating the error: e**

  The data set must be large enough to accommodate one error entry (length = 560 bytes) per defect that is detected by LOAD (for example, conversion errors, unique index violations, violations of referential constraints).

- **Calculating the number of possible defects:**

  – For discard processing, if the discard limit is specified, the number of possible defects is equal to the discard limit.

    If the discard limit is the maximum, calculate the number of possible defects by using the following formula:

    ```
    number of input records +
    (number of unique indexes * number of extracted keys) +
    (number of relationships * number of extracted foreign keys)
    ```

  – For nondiscard processing, the data set is not required.

Allocating twice the space that is used by the input data sets is usually adequate for the sort work data sets. Two or three large SORTWK*nn* data sets are preferable to several small ones.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. It is recommended that at least 1.2 times the amount of data to be sorted be provided in sort work data sets on disk.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

"Syntax and options of the TEMPLATE control statement" on page 789

Related information:

DFSORT Application Programming Guide

Concurrency and compatibility for LOAD

Depending on the specified LOAD utility options and the target object, certain processes and utilities can run at the same time as LOAD.

Claims and drains

The following table shows the claim classes that LOAD drains and the restrictive states the utility sets.

Table 37. Claim classes of LOAD operations

Target	LOAD SHRLEVEL NONE	LOAD PART SHRLEVEL NONE	LOAD SHRLEVEL CHANGE	LOAD PART SHRLEVEL CHANGE
Table space, index, or physical partition of a table space or index space	DA/UTUT	DA/UTUT	CW/UTRW	CW/UTRW
Nonpartitioned secondary index[1]	DA/UTUT	DR	CW/UTRW	CW/UTRW
Data-partitioned secondary index[2]	DA/UTUT	DA/UTUT	CW/UTRW	CW/UTRW
Index logical partition[3]	None	DA/UTUT	None	CW/UTRW
Primary index (with ENFORCE option only)	DW/UTRO	DW/UTRO	CR/UTRW	CR/UTRW
RI dependents	CHKP (NO)	CHKP (NO)	CHKP (NO)	CHKP (NO)

Legend:
- CHKP (NO): Concurrently running applications do not see CHECK-pending status after commit.
- CR: Claim the read claim class.
- CW: Claim the write claim class.
- DA: Drain all claim classes, no concurrent SQL access.
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTUT: Utility restrictive state, exclusive control.
- UTRO: Utility restrictive state, read-only access allowed.
- UTRW: Utility restrictive state, read/write access allowed.
- None: Object is not affected by this utility.

Note:

1. Includes the document ID indexes and node ID indexes over non-partitioned XML table spaces and XML indexes.
2. Includes document ID indexes and node ID indexes over partitioned XML table spaces.
3. Includes logical partitions of an XML index over partitioned table spaces.
4. For nonpartitioned secondary indexes, LOAD PART drains only the logical partition.

Compatibility

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

The following table shows whether other utilities are compatible with LOAD and can run concurrently on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space.

Table 38. Compatibility of LOAD with other utilities

Action	LOAD SHRLEVEL NONE	LOAD SHRLEVEL CHANGE
BACKUP SYSTEM	Yes	Yes

Table 38. Compatibility of LOAD with other utilities (continued)

Action	LOAD SHRLEVEL NONE	LOAD SHRLEVEL CHANGE
CHECK DATA DELETE NO	No	No
CHECK DATA DELETE YES	No	No
CHECK INDEX	No	No
CHECK LOB	No	No
COPY INDEXSPACE SHRLEVEL CHANGE	No	Yes
COPY INDEXSPACE SHRLEVEL REFERENCE	No	No
COPY TABLESPACE SHRLEVEL CHANGE	No	Yes
COPY TABLESPACE SHRLEVEL REFERENCE	No	No
COPYTOCOPY	No	Yes
DIAGNOSE	Yes	Yes
LOAD SHRLEVEL CHANGE	No	Yes
LOAD SHRLEVEL NONE	No	No
MERGECOPY	No	Yes
MODIFY RECOVERY	No	Yes
MODIFY STATISTICS	No	Yes
QUIESCE	No	No
REBUILD INDEX	No	No
RECOVER (no options)	No	No
RECOVER ERROR RANGE	No	No
RECOVER TOCOPY or TORBA	No	No
REORG INDEX	No	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	No	No
REPAIR DUMP or VERIFY	No	No
REPAIR LOCATE KEY or RID DELETE or REPLACE	No	No
REPAIR LOCATE TABLESPACE PAGE REPLACE	No	No
REPORT	Yes	No
RESTORE SYSTEM	No	No
RUNSTATS INDEX SHRLEVEL CHANGE	No	Yes
RUNSTATS INDEX SHRLEVEL REFERENCE	No	No
RUNSTATS TABLESPACE SHRLEVEL CHANGE	No	Yes

Table 38. Compatibility of LOAD with other utilities (continued)

Action	LOAD SHRLEVEL NONE	LOAD SHRLEVEL CHANGE
RUNSTATS TABLESPACE SHRLEVEL REFERENCE	No	No
STOSPACE	Yes	Yes
UNLOAD	No	Yes

SQL operations and other online utilities on the same target partition are incompatible.

Related concepts:

Claims and drains (DB2 Performance)

Preparing DB2 internal format input records that are not generated by UNLOAD for LOAD

Before you load records that are in DB2 internal format, but are not generated by the UNLOAD utility, you need to modify the input records.

About this task

For LOAD input records that are in DB2 internal format, the seventh bit of the first byte in each record needs to indicate whether the record is in basic row format or reordered row format. A value of 0 in the seventh bit of the first byte indicates that the record is in basic row format. A value of 1 indicates that the record is in reordered row format.

Procedure

If your input records are in DB2 internal format, and you did not use UNLOAD with FORMAT INTERNAL to generate the input data, you need to set the seventh bit of the first byte of each record to indicate the row format of the record.
To avoid extra row format conversions that degrade performance, ensure that input data rows are in the row format of the target table space or partition.

Related reference:

"Syntax and options of the LOAD control statement" on page 247

When to use SORTKEYS NO

The SORTKEYS value determines when you can restart a LOAD job on a table space that has LOB columns.

- The default value for SORTKEYS is SORTKEYS 0. If you plan to load a table that has LOB columns using LOAD RESUME YES SHRLEVEL NONE, and you might need to restart the LOAD job with RESTART(CURRENT), you must specify SORTKEYS NO.
- The point at which you can restart LOAD REPLACE SHRLEVEL NONE on a table that has no LOB columns depends on whether you specify SORTKEYS NO:
  - If you specify SORTKEYS NO, you can restart with RESTART(CURRENT).
  - If you do not specify SORTKEYS NO, you can restart only with RESTART(PHASE)

Loading variable-length data

You can load variable-length data by using the LOAD utility.

Procedure

To load variable-length data:

Include a 2-byte binary length field before each field of variable-length data. The value in that field depends on the data type of the column into which you load the data. Use:

- The number of single-byte characters if the data type is VARCHAR
- The number of double-byte characters if the data type is VARGRAPHIC

For example, assume that you have a variable-length column that contains X'42C142C142C2', which might be interpreted as either six single-byte characters or three double-byte characters. With the two-byte length field, use:

- **X'0006'**X'42C142C142C2' to signify six single-byte characters in a VARCHAR column
- **X'0003'**X'42C142C142C2' to signify three double-byte characters in a VARGRAPHIC column

How LOAD orders loaded records

The LOAD utility loads records into a table space in the order in which they appear in the input stream. It does not sort the input stream, and it does not insert records in sequence with existing records, even if a clustering index exists.

To achieve clustering when loading an empty table or replacing data, sort the input stream. When adding data to a clustered table, consider reorganizing the table after running LOAD.

Because rows with duplicate key values for unique indexes fail to be loaded, any records that are dependent on such rows either:

- Fail to be loaded because they would cause referential integrity violations (if you specify ENFORCE CONSTRAINTS)
- Are loaded without regard to referential integrity violations (if you specify ENFORCE NO)

As a result, violations of referential integrity might occur. Such violations can be detected by LOAD (without the ENFORCE(NO) option) or by CHECK DATA.

Replacing data with LOAD

You can use the LOAD utility to replace data in a table space that has one or more tables.

Procedure

To replace data with LOAD:

Specify the REPLACE option in the LOAD utility control statement.
This option specifies that all data in the table space is to be replaced. Alternatively, you can load new records into a table space without deleting the existing rows by using the RESUME option.

When you specify LOAD REPLACE, determine what other LOAD options to specify depending on the following implications:

How data sets are processed
DB2 processes data sets depending on the LOAD options that you specify. If you run LOAD REPLACE without the REUSE option, data sets that are not user-managed are deleted before the LOAD utility runs. The LOAD utility defines a new data set with a control interval that matches the page size.

How row format is affected
When you run LOAD REPLACE with the ROWFORMAT RRF option on a table space or partition that is in basic row format, LOAD converts the table space or partition to the reordered row format. If the ROWFORMAT BRF option is specified, existing basic row format table spaces are not converted to reordered row format. If the clause EDITPROC or VALIDPROC is used in a table space or partition, the table space or partition remains in basic format after the LOAD REPLACE. For table spaces that contain some partitions in basic row format and some partitions in reordered row format, LOAD REPLACE converts the partitions that are in basic row format to reordered row format.

How logging is handled
The LOAD REPLACE or PART REPLACE with LOG YES option logs only the reset and not each deleted row. To see what rows are being deleted, use the SQL DELETE statement.

Running LOAD REPLACE has the following effects on restrictive states:

REORG-pending
If an object is in REORG-pending status, you can run LOAD REPLACE on the entire table space, which resets REORG-pending status. You can also run LOAD PART REPLACE or RESUME on any partitions that are not in REORG-pending status. In this situation, no other LOAD operations are allowed.

Advisory REORG-pending
If an object is in advisory REORG-pending status, you can run LOAD REPLACE on the entire table space, which resets advisory REORG-pending status. The exception is pending limit key changes. LOAD REPLACE does not materialize those changes or reset advisory REORG-pending status. In that case, you must run the REORG TABLESPACE utility. Then, you can run LOAD REPLACE. (You can continue to use LOAD REPLACE to materialize immediate alter limit key changes, which are indicated by REORG-pending status instead of advisory REORG-pending status. Immediate alter limit key changes occur for a partitioned table space with index-controlled partitioning and any alter limit key operations that occur before Version 11 new-function mode.)

REBUILD-pending
If an object is in REBUILD-pending status, you can run LOAD REPLACE on the entire table space, which resets REBUILD-pending status. You can also run LOAD PART REPLACE or RESUME on any partitions. If these partitions are in REBUILD-pending status, a LOAD PART REPLACE or RESUME resets that status.

Advisory REBUILD-pending
If an object is in advisory REBUILD-pending status, you can run LOAD REPLACE on the entire table space, which resets advisory REBUILD-pending status.

REFRESH-pending
If a user-defined table space is in REFRESH-pending (REFP) status, you can replace the data by using LOAD REPLACE.

Examples

Example of replacing one table in a single-table table space
The following control statement specifies that LOAD is to replace one table in a single-table table space.

```
LOAD DATA
  REPLACE
  INTO TABLE DSN8B10.DEPT
  ( DEPTNO    POSITION (1)     CHAR(3),
    DEPTNAME  POSITION (5)     VARCHAR,
    MGRNO     POSITION (37)    CHAR(6),
    ADMRDEPT  POSITION (44)    CHAR(3),
    LOCATION  POSITION (48)    CHAR(16) )
  ENFORCE NO
```

Example of replacing one table in a multiple-table table space
LOAD works on an entire table space. Therefore, be careful when using LOAD REPLACE on a table space with multiple tables. To replace all rows in a multiple-table table space, you must work with one table at a time by using the RESUME YES option on all but the first table. For example, if you have two tables in a table space, take the following steps:

1. Use LOAD REPLACE on the first table as shown in the following control statement. This option removes data from the table space and replaces just the data for the first table.

   ```
   LOAD DATA CONTINUEIF(72:72)='X'
     REPLACE
     INTO DSN8B10.TOPTVAL
     ( MAJSYS    POSITION (2)    CHAR(1),
       ACTION    POSITION (4)    CHAR(1),
       OBJECT    POSITION (6)    CHAR(2),
       SRCHCRIT  POSITION (9)    CHAR(2),
       SCRTYPE   POSITION (12)   CHAR(1),
       HEADTXT   POSITION (80)   CHAR(50),
       SELTXT    POSITION (159)  CHAR(50),
       INFOTXT   POSITION (238)  CHAR(71),
       HELPTXT   POSITION (317)  CHAR(71),
       PFKTXT    POSITION (396)  CHAR(71),
       DSPINDEX  POSITION (475)  CHAR(2) )
   ```

2. Use LOAD with RESUME YES on the second table as shown in the control statement in the following example. This option adds the records for the second table without deleting the data in the first table.

   ```
   LOAD DATA CONTINUEIF(72:72)='X'
     RESUME YES
     INTO DSN8B10.TDSPTXT
     ( DSPINDEX  POSITION (2)     CHAR(2),
       LINENO    POSITION (6)     CHAR(2),
       DSPLINE   POSITION (80)    CHAR(79) )
   ```

If you want to replace just one table in a multiple-table table space, delete all rows in the table, and then use LOAD with RESUME YES. For example,

assume that you want to replace all the data in DSN8B10.TDSPTXT without changing any data in DSN8B10.TOPTVAL. In this case, take the following steps:

1. Delete all the rows from DSN8B10.TDSPTXT by using the following SQL DELETE statement:

```
EXEC SQL
   DELETE FROM DSN8B10.TDSPTXT
ENDEXEC
```

   Tip: The mass delete works most quickly on a segmented table space.

2. Use the LOAD job that is shown in the following figure to replace the rows in that table.

```
LOAD DATA CONTINUEIF(72:72)='X'
  RESUME YES
  INTO DSN8B10.TDSPTXT
  ( DSPINDEX  POSITION (2)     CHAR(2),
    LINENO    POSITION (6)     CHAR(2),
    DSPLINE   POSITION (80)    CHAR(79) )
```

Related concepts:

Improved availability when altering limit keys (DB2 for z/OS What's New?)

Related reference:

"Syntax and options of the LOAD control statement" on page 247

Chapter 29, "REORG TABLESPACE," on page 551

Appendix C, "Advisory or restrictive states," on page 1103

Loading tables with special column types by using generated LOAD statements

When you run the UNLOAD utility or the REORG utility with the UNLOAD EXTERNAL or DISCARD option, DB2 generates a LOAD statement for the unloaded data. You can then use this LOAD statement to load the unloaded data into any table that has a compatible format.

About this task

However, because the following types of columns can contain generated values, they need special consideration:

- ROWID columns
- Identity columns
- Row change timestamp columns
- Row-begin and row-end columns
- Transaction-start-ID columns
- Generated expression columns

For these table column types, the generated LOAD statement contains dummy fields. The following table lists those dummy fields.

Source table column type	Dummy fields in the generated LOAD statement
ROWID with GENERATED ALWAYS	DSN_ROWID
Identity column with GENERATED ALWAYS	DSN_IDENTITY

Source table column type	Dummy fields in the generated LOAD statement
Row change timestamp column with GENERATED ALWAYS	DSN_RCTIMESTAMP
Row-begin and row-end columns	DSN_ROWBEGIN and DSN_ROWEND
Transaction-start-ID columns	DSN_TRANSACTIONSTID
Generated expression columns	DSN_*column-name* (where *column-name* is the name of the column)

Procedure

To load tables with special column types by using generated LOAD statements

1. Make sure that the target table has a compatible format for the data that you want load.
2. Decide whether you want to include the data for the columns with special column types when you load the unloaded data.
3. If you do not want to load data for the columns with special column types, make sure that the column is defined in the target table as GENERATED ALWAYS.

   The IGNOREFIELDS keyword in the generated LOAD statement causes DB2 to skip the dummy fields when it loads the data into a table.
4. If you want to load data for the columns with special column types, take the following actions:

Option	Description
For ROWID, identity, or row change timestamp columns:	• In the target table, define the ROWID, identity, or row change timestamp column as GENERATED BY DEFAULT • In the generated LOAD control statement, remove the IGNOREFIELDS keyword and change the dummy field names to the corresponding column names in the target table.
For row-begin and row-end columns:	• In the target table, define the columns as GENERATED ALWAYS. • Make the following changes to the generated LOAD control statement: – Specify the OVERRIDE(SYSTEMPERIOD) option. – Remove the IGNOREFIELDS keyword. – Change the dummy field names to the corresponding column names in the target table.

Option	Description
For transaction-start-ID columns:	• In the target table, define transaction-start-ID columns as GENERATED ALWAYS • Make the following changes to the generated LOAD control statement: – Specify the OVERRIDE(TRANSID) option. – Remove the IGNOREFIELDS keyword. – Change the dummy field names to the corresponding column names in the target table.
For generated expression columns:	Make the following changes to the generated LOAD control statement: • Specify the OVERRIDE(NONDETERMINISTIC) option. • Remove the IGNOREFIELDS keyword. • Change the dummy field names to the corresponding column names in the target table.

5. Issue the LOAD utility control statement.

Related concepts:

"LOAD statements that are generated by UNLOAD" on page 876

Related reference:

"Syntax and options of the LOAD control statement" on page 247

"Syntax and options of the UNLOAD control statement" on page 818

CREATE TABLE (DB2 SQL)

Adding more data to a table or partition

You might want to use the LOAD utility to add data to a table or partition, rather than replacing existing data.

The RESUME keyword specifies whether data is to be loaded into an empty or a non-empty table space. RESUME NO loads records into an empty table space. RESUME YES loads records into a non-empty table space.

If RESUME NO is specified and the target table is not empty, no data is loaded.

If RESUME YES is specified and the target table is empty, data is loaded.

LOAD always adds rows to the end of the existing rows, but index entries are placed in key sequence.

Deleting all the data in a table space

You can use the LOAD utility to efficiently clean out a table space. You can delete all of the data, but retain the structure, including any views and privileges.

Procedure

To delete all the data in a table space:

Submit a LOAD job with the following specifications:

- Specify the REPLACE option in the utility control statement. LOAD REPLACE redefines the table space, but retains all views and privileges that are associated with a table space or table.
- Specify the appropriate LOG value in the utility control statement. If you want this job to be recoverable, specify LOG YES. Otherwise, specify LOG NO so that no rows are logged.
- Specify the input data set in the JCL as DD DUMMY. Such a data set indicates that no rows are to be loaded.

LOAD REPLACE replaces **all tables** in the table space.

Related reference:

"Syntax and options of the LOAD control statement" on page 247

"Data sets that LOAD uses" on page 304

Loading partitions

You can use the LOAD utility to load one or more partitions of a partitioned table space. To improve performance when loading more than one partition, consider enabling partition parallelism.

About this task

Partition parallelism can reduce the elapsed time that is required for loading large amounts of data into partitioned table spaces.

If you are loading a partitioned table space that is created with DEFINE NO, the load operation might take longer. If a partitioned table space is created with DEFINE NO, all partitions are also implicitly defined with DEFINE NO. The first data row that is inserted by the LOAD utility defines all data sets in the partitioned table space. If this process takes a long time, expect timeouts on the database descriptor (DBD).

Restriction: You cannot load data at the partition level of a partition-by-growth table space.

Procedure

To load partitions:

- If you want to load only certain partitions of a partitioned table, use the PART clause of the INTO TABLE option. If you omit the PART clause, the entire table is loaded.

  Restriction: The following restrictions exist for identity columns:
  - When index-based partitioning is used, LOAD INTO TABLE PART *integer* is not allowed if an identity column is part of the partitioning index.
  - When table-based partitioning is used, LOAD INTO TABLE PART *integer* is not allowed if an identity column is used in a partitioning clause of the CREATE TABLE or ALTER TABLE statement.

To override these restrictions, specify the OVERRIDE(IDENTITY) option in the LOAD statement.

- If you want partitions to be processed in parallel, take one of the following actions:
  - If you have a single input data set and the partitioned table space is partitioned (non-universal) or range-partitioned, specify the PARALLEL keyword. This keyword enables LOAD to use multiple parallel subtasks. When determining the degree of parallelism to specify on the PARALLEL keyword, consider that a high degree of parallelism can result in increased processor time.

    Recommendation: Specify PARALLEL(0) or PARALLEL without a number so that DB2 can determine the optimal degree of parallelism.
  - If one or more nonpartitioned secondary indexes exists on the partitioned table space, and you have a separate input data set for each partition, use load partition parallelism. Partition parallelism loads all partitions in a single job. To invoke partition parallelism, specify the INTO TABLE PART clause with INDDN or INCURSOR and optionally DISCARDDN for each partition that you want to load.

    If the table space is created with DEFINE NO, specifying SHRLEVEL CHANGE on your LOAD statement and enabling partition parallelism is equivalent to concurrent, independent insert jobs. For example, in a large partitioned table space that is created with DEFINE NO, the LOAD utility starts three tasks. The first task tries to insert the first row, which causes an update to the DBD. The other two tasks time out while they wait to access the DBD. The first task holds the lock on the DBD while the data sets are defined for the table space.
  - If the only indexes are the partitioned indexes, use multiple jobs to run LOAD concurrently against separate partitions. This method also requires that you have a separate input data set for each partition.
- If you use the INTO TABLE PART clause, take the following actions as appropriate:
  - If you specify the REPLACE or RESUME options, specify them separately by partition. If you specify these options before the INTO TABLE PART clause, LOAD serializes the load operation for the entire table space and does not process the partitions concurrently.
  - To load columns in an order that is different than the order of the columns in the CREATE TABLE statement, code field specifications for each INTO TABLE PART clause.
  - Make sure that you specify the LOAD options in the appropriate place in the utility statement. Some LOAD options, such as INDDN, DISCARDDN, RESUME, and REPLACE, can have a different scope depending on their placement in the LOAD statement. For example, if you specify INDDN before INTO TABLE, the specified input data set is used to load the entire table. However, if you specify INDDN after INTO TABLE, in a PART clause, the specified input data set is used to load only the specified partition.
- If you want DB2 to save copies of records that are not loaded, use the DISCARDDN option to specify a discard data set as follows:
  - If you want a single discard data set for all partitions, specify DISCARDDN before INTO TABLE. If you use a template for this data set, and the TEMPLATE utility statement contains the variable $PA. or $PART., that variable is substituted with 0 or the partition number in the first INTO TABLE PART clause.

– If you want one discard data set for a partition, specify DISCARDDN in an INTO TABLE PART clause. If you use a template for this data set, and the TEMPLATE utility statement contains the variable $PA. or $PART., that variable is substituted with the partition number. If you specify DISCARDDN in more than one INTO TABLE PART clause, you must ensure that the data set names are unique. One way to ensure unique names is to use templates and the variable $PA. or $PART. in the TEMPLATE statement.

Examples

Example of loading certain records into certain partitions

The control statement in the following example specifies that DB2 is to load data into the first and second partitions of the employee table. Records with '0' in column 1 replace the contents of partition 1; records with '1' in column 1 are added to partition 2; all other records are ignored. This example control statement, which is simplified to illustrate the point, does not list field specifications for all columns of the table.

```
LOAD DATA CONTINUEIF(72:72)='X'
  INTO TABLE DSN8B10.EMP PART 1 REPLACE WHEN (1) = '0'
  ( EMPNO     POSITION (1:6)  CHAR(6),
    FIRSTNME  POSITION (7:18) CHAR(12),

⋮
                                        )
  INTO TABLE DSN8B10.EMP PART 2 RESUME YES WHEN (1) = '1'
  ( EMPNO     POSITION (1:6)  CHAR(6),
    FIRSTNME  POSITION (7:18) CHAR(12),

⋮
                                       )
```

Example of loading partitions from separate input data sets

The following example LOAD statements specify that partitions 1 and 2 of the EMP table are to be loaded from the EMPLDS1 and EMPLDS2 data sets. This example assumes that your data is in separate input data sets and already sorted by partition. Therefore, you do not need to use the WHEN clause of INTO TABLE. Placing the RESUME YES option before the PART option inhibits concurrent partition processing. If you want LOAD to process other partitions concurrently, specify the RESUME option after the PART option.

```
LOAD DATA INDDN EMPLDS1 CONTINUEIF(72:72)='X'
  RESUME YES
  INTO TABLE DSN8B10.EMP REPLACE PART 1

LOAD DATA INDDN EMPLDS2 CONTINUEIF(72:72)='X'
  RESUME YES
  INTO TABLE DSN8B10.EMP REPLACE PART 2
```

Example of loading partitions independently

In the following example, partition 1 and partition 2 are loaded concurrently.

```
LOAD DATA INDDN SYSREC LOG NO
  INTO TABLE DSN8B10.EMP PART 1 REPLACE

LOAD DATA INDDN SYSREC2 LOG NO
  INTO TABLE DSN8B10.EMP PART 2 REPLACE
```

Example of specifying separate discard data sets for each partition

If you specify multiple discard data sets, you must ensure that the data set names are unique. In the following example, the LOAD statement specifies that two discard data sets are to be allocated, one for each partition. Those

discard data sets both use the DT template. The TEMPLATE statement for DT includes the &PA. variable (partition number) to ensure that the data set name is different for each partition.

```
TEMPLATE DT UNIT(SYSDA)
                          DSN(JUOSU339.&TS..P&PA..DISCARD)
                          SPACE(50,10) TRK
LOAD DATA
 INTO TABLE DSN8B10.EMP PART 1 INDDN D1 DISCARDDN(DT) REPLACE NO RESUME
 INTO TABLE DSN8B10.EMP PART 2 INDDN D2 DISCARDDN(DT) REPLACE NO RESUME
```

Related reference:

"Syntax and options of the LOAD control statement" on page 247

"Syntax and options of the TEMPLATE control statement" on page 789

Partition-by-growth table spaces

When you load a partition-by-growth table space, you can load data only at the table space level and not at the partition level. If you need additional partitions during the LOAD process and the maximum number of partitions for the table space is not yet reached, the LOAD utility will trigger the process to add additional partitions. If the maximum number of partitions is reached, the LOAD utility fails.

Restriction: You cannot use parallelism for LOAD processing for partition-by-growth table spaces.

Loading data containing XML columns

You can load data containing XML columns with one of two methods.

About this task

- The XML column can be loaded from the input record. XML column value can be placed in the INPUT record with or without any other any other loading column values. The input record can be in delimited or non-delimited format. For a non-delimited format, the XML column is treated like a variable character with a 2-byte length preceding the XML value. For a delimited format there are no length bytes present. If the input record is in spanned record format, specify the FORMAT SPANNED YES option.
- The XML column can be loaded from a separate file whether the XML column length is less than 32K or not.

Procedure

To load data into a base table that has XML columns:

1. Create input data sets to ensure that you use the appropriate format:
   - If you use delimited format, specify XML data in the input data set as delimited character strings, separated by the column delimiter.
   - If you do not use delimited format, specify the XML input field length in a 2-byte binary field preceding the data.
2. Create a LOAD utility control statement.
   - To load XML directly from input record, specify XML as the input field type. XML is the only acceptable field type and data type conversion is not supported. Do not specify DEFAULTIF.

- To load XML from a file, specify CHAR or VARCHAR along with either BLOBF, CLOBF or DBCLOBF to indicate that the input column contains a filename from which a BLOBF, CLOBF or DBCLOBF is to be loaded to the XML column.

3. Submit the utility control statement.

Results

When you load XML documents into a table, and the XML value cannot be cast to the type that you specified when you created the index, the value is ignored without any warnings or errors, and the document is inserted into the table.

When you insert XML documents into a table with XML indexes that are of type DECFLOAT, the values might be rounded when they are inserted. If the index is unique, the rounding might cause duplicates even if the original values are not exactly the same.

DB2 does not compress an XML table space during the LOAD process. If the XML table space is defined with COMPRESS YES, the XML table space is compressed during REORG.

Loading delimited files

You can load a delimited file by using the FORMAT DELIMITED option. A delimited file contains cell values that are separated by delimiters. *Delimiters* are predefined characters that separate data. The column delimiter separates one column value from the next. Character string delimiters identify the beginning and end of a single cell value and are required only if the cell value contains the column delimiter.

Recommendation: If a delimited file is to be transferred to or from an operating system other than z/OS or between DB2 for z/OS systems that use different EBCDIC or ASCII CCSIDs, use Unicode as the encoding scheme for the delimited file. Using Unicode avoids possible CCSID translation problems.

You are responsible for ensuring that the data in the file does not include the chosen delimiters. If the delimiters are part of the file's data, unexpected errors can occur.

Restrictions: The following restrictions apply to the use of delimiters:

- You cannot specify the same character for more than one type of delimiter (COLDEL, CHARDEL, and DECPT).
- You cannot specify a character constant for a delimiter if the utility control statement is not coded in the same encoding scheme as the input file. For example, the utility control statement is coded in Unicode, and the input data is coded in EBCDIC.
- You should use the hexadecimal representation for non-default delimiters if the utility control statement is coded in a different encoding scheme than the input file. For example, the utility control statement is coded in Unicode, and the input file is coded in EBCDIC. In this case, if you do not use the hexadecimal representation for the non-default delimiters, the results can be unpredictable.
- You do not need to specify the POSITION keyword when you specify the DELIMITED option. The utility ignores the POSITION keyword when you also specify DELIMITED. The utility overrides field data type specifications according to the specifications of the delimited format. (For example, length

values for CHAR, VARCHAR, GRAPHIC, VARGRAPHIC, CLOB, DBCLOB, and BLOB data are the delimited lengths of each field in the input data set, and the utility expects all numeric types in external format.)

- You cannot specify a binary 0 (zero) for any delimiter.
- You cannot specify the default decimal point as a string character delimiter (CHARDEL) or a column string delimiter (COLDEL).
- You cannot specify shift-in and shift-out characters for EBCDIC MBCS data.
- You cannot specify the pipe character (|) for DBCS data.
- You cannot specify the semicolon character (x'5E') as a delimiter character for COlDEL.
- You must enclose all space values with CHARDEL if you want to load the character string into a target column that is defined with NOT NULL and without the default value. If a character string is not enclosed by CHARDEL, the utility skips the leading and trailing space characters. If the characters between two column delimiters are all space values, the field is set to null and cannot be loaded into a column.

The following table lists the default hexadecimal values for the delimiter characters based on encoding scheme.

Table 39. Default delimiter values for different encoding schemes

Character	EBCDIC SBCS	EBCDIC DBCS/MBCS	ASCII/Unicode SBCS	ASCII/Unicode MBCS
Character string delimiter	X'7F'	X'7F'	X'22'	X'22'
Decimal point character	X'4B'	X'4B'	X'2E'	X'2E'
Column delimiter	X'6B'	X'6B'	X'2C'	X'2C'

In most EBCDIC code pages, the hexadecimal values that are specified in the previous table are a double quotation mark(") for the character string delimiter, a period(.) for the decimal point character, and a comma(,) for the column delimiter.

The following table lists the maximum allowable hexadecimal values for any delimiter character based on the encoding scheme.

Table 40. Maximum delimiter values for different encoding schemes

Encoding scheme	Maximum allowable value
EBCDIC SBCS	None
EBCDIC DBCS/MBCS	X'3F' (X'7F', X'4B', X'6B' are also allowed.)
ASCII/Unicode SBCS	None
ASCII/Unicode MBCS	X'7F'

The following table identifies the acceptable data type forms for the delimited file format that the LOAD and UNLOAD utilities use.

Table 41. Acceptable data type forms for delimited files

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file
CHAR, VARCHAR	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. For VARCHAR, length bytes do not precede the data in the string.
GRAPHIC (any type)[4]	A delimited or non-delimited character stream	Data that is unloaded as a delimited character string. For VARGRAPHIC, length bytes do not precede the data in the string.
INTEGER (any type)[1]	A stream of characters that represents a number in EXTERNAL format	Numeric data in external format.
DECIMAL (any type) [2]	A character string that represents a number in EXTERNAL format	A string of characters that represents a number.
DECFLOAT EXTERNAL	A character string that represents	A SQL numeric constant.
FLOAT [3]	A representation of a number in the range `-7.2E+75` to `7.2E+75` in EXTERNAL format	A string of characters that represents a number in floating-point notation.
BLOB, CLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.
DBCLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.
DATE	A delimited or non-delimited character string that contains a date value in EXTERNAL format	Character string representation of a date.
TIME	A delimited or non-delimited character string that contains a time value in EXTERNAL format	Character string representation of a time.
TIMESTAMP	A delimited or non-delimited character string that contains a timestamp value in EXTERNAL format	Character string representation of a timestamp.
TIMESTAMP WITH TIME ZONE	A delimited or non-delimited character string that contains a timestamp with time zone value in EXTERNAL format	Character string representation of a timestamp with time zone.

Table 41. Acceptable data type forms for delimited files (continued)

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file

Note:

1. Field specifications of INTEGER or SMALLINT are treated as INTEGER EXTERNAL.
2. Field specifications of DECIMAL, DECIMAL PACKED, or DECIMAL ZONED are treated as DECIMAL EXTERNAL.
3. Field specifications of FLOAT, REAL, or DOUBLE are treated as FLOAT EXTERNAL.
4. EBCID graphic data must be enclosed in shift-out and shift-in characters.

Related concepts:

"Unloading delimited files" on page 873

Related reference:

Appendix I, "Delimited file format," on page 1203

Loading data with referential constraints

LOAD does not load a table with an incomplete definition; if the table has a primary key, the unique index on that key must exist. If any table that is to be loaded has an incomplete definition, the LOAD job terminates.

LOAD requires access to the primary indexes on the parent tables of any loaded tables. For simple, segmented, and partitioned table spaces, it drains all writers from the parent table's primary indexes. Other users cannot make changes to the parent tables that result in an update to their own primary indexes. Concurrent inserts and deletes on the parent tables are blocked, but updates are allowed for columns that are not defined as part of the primary index.

By default, LOAD enforces referential constraints, except informational referential constraints, which LOAD ignores. By enforcing referential constraints, LOAD provides you with several possibilities for error:

- Records that are to be loaded might have duplicate values of a primary key.
- Records that are to be loaded might have invalid foreign-key values, which are not values of the primary key of the corresponding parent table.
- The loaded table might lack primary key values that are values of foreign keys in dependent tables.

The next few paragraphs describe how DB2 signals each of those errors and the means it provides for correcting them.

Duplicate values of a primary key

A primary index must be a unique index and must exist if the table definition is complete. Therefore, when you load a parent table, you build at least its primary index. You need an error data set, and probably also a map data set and a discard data set.

Invalid foreign key values:

A dependent table has the constraint that the values of its foreign keys must be values of the primary keys of corresponding parent tables. By default, LOAD enforces that constraint in much the same way as it enforces the uniqueness of key values in a unique index. First, it loads all records to the table. Subsequently,

LOAD checks the validity of the records with respect to the constraints, identifies any invalid record by an error message, and deletes the record from the table. You can choose to copy this record to a discard data set. Again you need at least an error data set, and probably also a map data set and a discard data set.

If a record fails to load because it violates a referential constraint, any of its dependent records in the same job also fail. For example, suppose that the sample project table and project activity tables belong to the same table space, that you load them both in the same job, and that some input record for the project table has an invalid department number. Then, that record fails to be loaded and does not appear in the loaded table; the summary report identifies it as causing a **primary** error.

However the project table has a primary key, the project number. In this case, the record that is rejected by LOAD defines a project number, and any row in the project activity table that refers to the rejected number is also rejected. The summary report identifies those as causing **secondary** errors. If you use a discard data set, records for both types of errors are copied to it.

Missing primary key values

The deletion of invalid records does not cascade to other dependent tables that are already in place. Suppose now that the project and project activity tables exist in separate table spaces, and that they are both currently populated and possess referential integrity. In addition, suppose that the data in the project table is now to be replaced (using LOAD REPLACE) and that the replacement data for some department was inadvertently not supplied in the input data. Rows that reference that department number might already exist in the project activity table. LOAD, therefore, automatically places the table space that contains the project activity table (and all table spaces that contain dependent tables of any table that is being replaced) into CHECK-pending status.

The CHECK-pending status indicates that the referential integrity of the table space is in doubt; it might contain rows that violate a referential constraint. DB2 places severe restrictions on the use of a table space in CHECK-pending status; typically, you run the CHECK DATA utility to reset this status.

Consequences of ENFORCE NO

If you use the ENFORCE NO option, you tell LOAD not to enforce referential constraints. Sometimes you have good reasons for doing that, but the result is that the loaded table space might violate the constraints. Hence, LOAD places the loaded table space in CHECK-pending status. If you use REPLACE, all table spaces that contain any dependent tables of the tables that were loaded are also placed in CHECK-pending status. You must reset the status of each table before you can use any of the table spaces.

Related concepts:

"CHECK-pending status after running LOAD" on page 354

Referential constraint violations

The referential integrity checking in LOAD can delete only incorrect dependent rows, which were input to LOAD. In some circumstances, it is possible to correct referential integrity violations without deleting the dependent rows.

For example, the violations might occur because parent rows do not exist. In this case, correcting the parent tables is better than deleting the dependent rows. In this case, ENFORCE NO is more appropriate than ENFORCE CONSTRAINTS. After you correct the parent table, you can use CHECK DATA to reset the CHECK-pending status.

LOAD ENFORCE CONSTRAINTS is not equivalent to CHECK DATA. LOAD ENFORCE CONSTRAINTS deletes any rows that cause referential constraint violations. CHECK DATA detects violations and optionally deletes such rows. CHECK DATA checks a complete referential structure, although LOAD checks only the rows that are being loaded.

When loading referential structures with ENFORCE CONSTRAINTS, you should load tables before dependent tables.

Compressing data by using the LOAD utility

You can use LOAD to compress data in a table space or partition that is defined with COMPRESS YES. LOAD first builds a compression dictionary. After the dictionary is built, the data is compressed as it is loaded. If a compression dictionary already exists, you can specify that LOAD not build a new one.

Alternatively, you can run the REORG TABLESPACE utility to compress your data.

Before you begin

Your table space or partition in a partitioned table space must be defined with COMPRESS YES before you can compress the data by using LOAD.

Introductory concepts:

The effect of data compression on performance (Introduction to DB2 for z/OS)

About this task

LOAD creates a compression dictionary while records are loaded. The data is not compressed until the dictionary is built. To save processing costs, the initial LOAD does not go back to compress the records that were used to build the dictionary. After the dictionary is built, the rest of the data is compressed as it is loaded.

The number of records that are required to build a dictionary depends on the frequency of patterns in the data. For large data sets, a small percentage of the total number of rows is used to build the dictionary. For the best compression results, build a new dictionary whenever you load the data. If a table has DATA CAPTURE CHANGES active, any previously existing dictionary is written to the log.

For partition-by-growth table spaces, the utility builds one dictionary and the same dictionary page is populated through all partitions.

For XML table spaces that are defined with COMPRESS YES, compression does not occur until the first time that the REORG TABLESPACE utility is run on that table space.

Procedure

To compress data by using the LOAD utility:

- **If a compression dictionary does not already exist or you want to build a new one,** specify the REPLACE, RESUME NO, or RESUME YES options in the LOAD statement as follows:

  REPLACE
  For simple table spaces, you must specify LOAD REPLACE to build new compression dictionaries. If you specify RESUME YES or RESUME NO for a simple table space, LOAD keeps the existing dictionary if one exists. Alternatively, you can run REORG TABLESPACE.

  RESUME NO
  If you specify RESUME NO, the table space must be empty.

  RESUME YES
  If you specify RESUME YES and SHRLEVEL NONE is explicitly or implicitly specified, LOAD builds a dictionary if the table space is empty. If you specify RESUME YES SHRLEVEL CHANGE, LOAD builds a dictionary when the amount of data in the table space reaches a threshold that is determined by DB2.

- **If you want to use an existing compression dictionary to compress the data,** specify the KEEPDICTIONARY option in the LOAD statement.

  Alternatively, you can run REORG TABLESPACE with the KEEPDICTIONARY option to compress the data. REORG TABLESPACE with KEEPDICTIONARY is efficient, because the data is not decompressed in the process. However, REORG TABLESPACE with KEEPDICTIONARY does not generate a compression report. To get that information, run RUNSTATS to update the catalog statistics and then query the catalog columns yourself.

  One advantage of reusing an existing compression dictionary is that you can eliminate the utility processing time of building the dictionary. Consider specifying KEEPDICTIONARY in the LOAD statement in the following situations:

  – If you are satisfied with the compression that is obtained from an existing dictionary.
  – If the last dictionary was built by REORG TABLESPACE. The REORG TABLESPACE sampling method can yield more representative dictionaries than LOAD and can thus result in a better compression.
  – If the data is not changed significantly since the last dictionary was built.

  You can also specify KEEPDICTIONARY for specific partitions of a partitioned table space. In this case, each partition has its own dictionary.

  The following example LOAD statement reuses an existing compression dictionary:

```
LOAD DATA
  REPLACE KEEPDICTIONARY
  INTO TABLE DSN8B10.DEPT
  ( DEPTNO    POSITION (1)     CHAR(3),
    DEPTNAME  POSITION (5)     VARCHAR,
    MGRNO     POSITION (37)    CHAR(6),
    ADMRDEPT  POSITION (44)    CHAR(3),
    LOCATION  POSITION (48)    CHAR(16) )
  ENFORCE NO
```

- **If you want to copy another compression dictionary from an existing partition into another empty partition,** specify the COPYDICTIONARY option in the

LOAD statement and use a dummy input data set. In this case, the data that is inserted into the partition is compressed.

What to do next

For XML table spaces, run REORG TABLESPACE on the table space.

Related tasks:

Compressing your data (DB2 Performance)

Related reference:

Chapter 29, "REORG TABLESPACE," on page 551

Chapter 33, "RUNSTATS," on page 737

How to load data from DL/I

You can convert data in IMS DL/I databases from a hierarchic structure to a relational structure so that it can be loaded into DB2 tables. To do that, use the DataRefresher™ and IMS DataPropagator (IMS DPROP) licensed programs.

About this task

You can use DataRefresher to create source-to-target mappings and to create DB2 databases. After your databases are created and the mappings are set, you can use IMS DPROP to propagate any changes.

IMS DPROP runs as a z/OS application and can extract data from VSAM and physical sequential access method (SAM) files, as well from DL/I databases. Using IMS DPROP, you do not need to extract all the data in a database or data set. You use a statement such as an SQL subselect to indicate which fields to extract and which conditions, if any, the source records or segments must meet.

With JCL models that you edit, you can have IMS DPROP produce the statements for a DB2 LOAD utility job. If you have more than one DB2 subsystem, you can name the one that is to receive the output. IMS DPROP can generate LOAD control statements in the job to relate fields in the extracted data to target columns in DB2 tables.

You have the following choices for how IMS DPROP writes the extracted data:

- 80-byte records, which are included in the generated job stream
- A separate physical sequential data set (which can be dynamically allocated by IMS DPROP), with a logical record length that is long enough to accommodate any row of the extracted data

In the first case, the LOAD control statements that are generated by IMS DPROP include the CONTINUEIF option to describe the extracted data to DB2 LOAD.

In the second case, you can have IMS DPROP name the data set that contains the extracted data in the SYSREC DD statement in the LOAD job. (In that case, IMS DPROP makes no provision for transmitting the extracted data across a network.)

Normally, you do not need to edit the job statements that are produced by IMS DPROP. However, in some cases you might need to edit; for example, if you want to load character data into a DB2 column with INTEGER data type, you need to edit the job statements. (DB2 LOAD does not consider CHAR and INTEGER data to be compatible.)

IMS DPROP is a versatile tool that contains more control, formatting, and output options than are described here. For more information about this tool, see IMS DataPropagator: An Introduction.

Loading data by using the cross-loader function

The LOAD utility can directly load the output of a dynamic SQL SELECT statement into a table. The dynamic SQL statement can be executed on data at a local server or at any remote server that complies with DRDA. This functionality is called the DB2 family cross-loader function.

About this task

This function enables you to use a single LOAD job to transfer data from one location to another location or from one table to another table at the same location. Your input for this cross-loader function can come from other sources besides DB2 for z/OS; you can use IBM Information Integrator Federation feature for access to data from sources as diverse as Oracle and Sybase, as well as the entire DB2 family of database servers.

Note: If a table that uses row or column access control security is either the data source or a load target for the cross-loader function, the data is subject to the rules defined in the corresponding row permissions or column masks. The CONTROL column in SYSIBM.SYSTABLES indicates whether row or column access control is activated for a table.

Procedure

To load data by using the cross-loader function:

1. Declare a cursor by using the EXEC SQL utility. Within the cursor definition, specify a SELECT statement that identifies the result table that you want to use as the input data for the LOAD job. Use the following rules when writing the SELECT statement:
   - The column names in the SELECT statement must be identical to the column names in the table that is being loaded. You can use the AS clause in the SELECT list to change the column names that are returned by the SELECT statement so that they match the column names in the target table.
   - The columns in the SELECT list do not need to be in the same order as the columns in the target table.
   - The SELECT statement needs to refer to any remote tables by their three-part name.
   - Although you do not need to specify casting functions for any distinct types in the input data or target table, you might need to add casting functions to any additional WHERE clauses in the SQL.
2. Specify the cursor name with the INCURSOR option in the LOAD statement. You cannot load the input data into the same table on which you defined the cursor. You can, however, use the same cursor to load multiple tables.

Results

When you submit the LOAD job, DB2 parses the SELECT statement in the cursor definition and checks for errors. If the statement is invalid, the LOAD utility issues an error message and identifies the condition that prevented the execution. If the statement syntax is valid but an error occurs during execution, the LOAD utility

also issues an error message. The utility terminates when it encounters an error. If you specify a data-change-table-reference in the from-clause of the cursor, the changes to the source might be committed even though the load fails.

If no errors occur, the utility loads the result table that is identified by the cursor into the specified target table according to the following rules:

- LOAD matches the columns in the input data to columns in the target table by name, not by sequence.
- If the number of columns in the cursor is less than the number of columns in the table that is being loaded, DB2 loads the missing columns with their default values. If the missing columns are defined as NOT NULL without defaults, the LOAD job fails.
- If a source column is defined as NULLABLE and the corresponding target column is defined as NOT NULL without defaults, the LOAD job fails.
- If you specify IGNOREFIELDS YES, LOAD skips any columns in the input data that do not exist in the target table.
- If the data types in the target table do not match the data types in the cursor, DB2 tries to convert the data as much as possible. If the conversion fails, the LOAD job fails. You might be able to avoid these conversion errors by using SQL conversion functions in the SELECT statement of the cursor declaration.
- If the encoding scheme of the input data is different from the encoding scheme of the target table, DB2 converts the encoding schemes automatically. Make sure that the length definition in the target table is able to fit the converted data.
- If the target table has GENERATED ALWAYS columns and you try to load data into them, the LOAD job fails. To avoid this situation, either do not specify these columns in the SELECT statement for the cursor or specify in the LOAD statement that you want to override these columns.

Also, although you do not need to specify casting functions for any distinct types in the input data or target table, you might need to add casting functions to any additional WHERE clauses in the SQL.

Related concepts:

"Before running LOAD" on page 303

Related reference:

"Sample LOAD control statements" on page 359

SYSIBM.SYSTABLES table (DB2 SQL)

How to use inline COPY with LOAD

You can create a full image copy data set (SHRLEVEL REFERENCE) during LOAD execution. The new copy is an inline copy.

About this task

The advantage to using an inline copy is that the table space is not left in COPY-pending status regardless of which LOG option was specified for the utility. Thus, data availability is increased.

Procedure

To create an inline copy:

Use the COPYDDN and RECOVERYDDN keywords. You can specify up to two primary and two secondary copies. Inline copies are produced during the RELOAD phase of LOAD processing. You must specify LOAD REPLACE. If you specify RESUME YES or RESUME NO but not REPLACE, an error message is issued and LOAD terminates.
The SYSCOPY record that is produced by an inline copy contains ICTYPE=F and SHRLEVEL=R. The STYPE column contains an R if the image copy was produced by LOAD REPLACE LOG(YES). It contains an S if the image copy was produced by LOAD REPLACE LOG(NO). The data set that is produced by the inline copy is logically equivalent to a full image copy with SHRLEVEL REFERENCE, but the data within the data set differs in the following ways:

- Data pages might be out of sequence and some might be repeated. If pages are repeated, the last one is always the correct copy.
- Space map pages are out of sequence and might be repeated.
- If the compression dictionary is rebuilt with LOAD, the set of dictionary pages occurs twice in the data set, with the second set being the correct one.

The total number of duplicate pages is small, with a negligible effect on the required space for the data set.

Related tasks:

"Replacing data with LOAD" on page 313

Related reference:

"COPY-pending status" on page 1106

Creating a FlashCopy image copy with LOAD

As part of LOAD processing, you can use FlashCopy technology to take image copies. This method is potentially faster than the traditional DB2 utility methods for creating inline copies and thus reduces the time that data is unavailable. FlashCopy image copies can also potentially reduce the time that is required for recovery operations.

About this task

LOAD can also create one to four additional inline image copies by using the traditional methods. Traditional inline image copies are output to a non-VSAM sequential format data set. For more information about creating traditional inline copies, see "How to use inline COPY with LOAD" on page 332.

Procedure

To create a FlashCopy image copy with LOAD:

Specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT) in the LOAD utility control statement.
Specify FLASHCOPY(CONSISTENT) if you specify SHRLEVEL CHANGE and want to ensure that the image copy is consistent for recovery purposes. Otherwise, specify FLASHCOPY(YES). Also, be aware that if you specify CONSISTENT rather than YES, the process of creating an image copy could take longer.

Restriction: You cannot specify CONSISTENT when copying objects that have been defined with the NOT LOGGED attribute.
As an alternative to specifying FLASHCOPY in the LOAD statement, you can set the FLASHCOPY_LOAD subsystem parameter to YES, which specifies that LOAD is to use FLASHCOPY(YES) by default. The value that you specify for the

FLASHCOPY option in the LOAD statement always overrides the value for the FLASHCOPY_LOAD subsystem parameter.
Optionally, you can also specify FCCOPYDDN in the LOAD statement. Use this option to specify a template for the FlashCopy image copy. If you do not specify the FCCOPYDDN option in the LOAD statement, the utility uses the value from the FCCOPYDDN subsystem parameter.

Restriction: The data sets that you specify for the FlashCopy image copy must be on FlashCopy Version 2 disk volumes.
When you specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT), LOAD uses FlashCopy technology to create a copy of the table space after the data is loaded. If you also requested one or more inline copies in the LOAD statement (by specifying REPLACE and COPYDDN or RECOVERYDDN), the utility also creates those copies. LOAD does not use the FlashCopy image copy to create those traditional inline copies.
Any indexes that are defined with the COPY YES attribute are also copied with FlashCopy technology.
The FlashCopy image copy fails if the FlashCopy Version 2 disk volumes are not available or if any of the other FlashCopy operational restrictions exist. For a list of those operational restrictions, see "FlashCopy image copies" on page 163.
If the FlashCopy copy fails for the target object or auxiliary object and the LOAD statement includes LOG NO but not NOCOPYPEND, the table space is set to COPY-pending status.

Related concepts:

"FlashCopy image copies" on page 163

Related reference:

DEFAULT TEMPLATE field (FCCOPYDDN subsystem parameter) (DB2 Installation and Migration)

LOAD field (FLASHCOPY_LOAD subsystem parameter) (DB2 Installation and Migration)

Improving LOAD performance

Depending on the data, target object, and available resources, you can take certain actions that might improve the performance of the LOAD utility. For example, you can preprocess the input data or specify a particular LOAD option.

About this task

Be aware that the performance of LOAD on a table that is organized by hash is likely to be slower. The reason is that the rows are loaded according to the hash key rather than sequentially on the pages.

Procedure

To improve LOAD performance, complete one or more of the following recommended actions as appropriate:

- Load numeric data in internal format. *DB2 internal format* is the format that is produced by running UNLOAD with the FORMATINTERNAL option.
- If you specify LOAD REPLACE, specify LOG NO with COPYDDN or RECOVERYDDN to create an inline copy.
- **Preprocess input data:** Present data to LOAD in the optimal order, as follows:
  - Sort the data in cluster order to avoid needing to reorganize it after loading.

– If you are loading a single table that has, at most, one foreign key or one index key, sort the data in key sequence. (An index over a foreign key is allowed.) If the key is an index key, sort the data in either ascending or descending order, depending on how the index was defined. If the key is a foreign key, sort the data in ascending order. Null key values are treated as "high" values.
– If you are loading more than one table, choose one of the following methods:
  - Load each table separately. If you use this method, you can follow the rules that are listed in the preceding bullet for loading single tables.
  - Use the WHEN clause under each INTO TABLE option on your LOAD statement to group your input data by table.

  Within each table, sort the data in key sequence.

If you do presort the data, specify the PRESORTED YES option in the LOAD statement.

Do any other preprocessing of the input data, as described in "Before running LOAD" on page 303.

- **Avoid conversions:**
  – If possible, avoid data conversion, such as from integer to decimal or from decimal to floating-point.
  – Avoid CCSID and encoding scheme conversions, if possible, by loading data that has the same CCSID as the target table. If you specify a CCSID or encoding scheme option that does not match that of the table that is being loaded, CCSID conversions can occur.

  Related information:

  Situations in which character conversion occurs (DB2 Internationalization Guide)
- **Avoid LOB and XML materialization:** To eliminate the need to load large LOBs or XML documents into virtual storage while LOAD is running, use file reference variables for the following data:
  – For XML data that is greater than 32 KB in size.
  – For large LOB data in a row with only 1 LOB. (Large LOBs are usually considered to be 2 MB or greater in size.)

  In these cases, LOAD does not materialize LOB or XML data into memory.
- **Use parallelism:** Enable LOAD to use parallelism when possible to reduce the elapsed time for loading large amounts of data. To enable parallelism, take one of the following actions:
  – If the table space is simple, segmented (non-universal), partitioned (non-universal), or range-partitioned and all of the data to be loaded is in a single data set, specify the PARALLEL keyword. This keyword enables LOAD to use multiple parallel subtasks. When you determine the degree of parallelism to specify on the PARALLEL keyword, consider that a high degree of parallelism can result in increased processor time. The recommended value is to specify PARALLEL(0) or PARALLEL without a number so that DB2 can determine the optimal degree of parallelism.
  – If the table space is partitioned and one or more nonpartitioned secondary indexes exist, and you have a separate input data set for each partition, use partition parallelism. Partition parallelism loads all partitions in a single job. To invoke partition parallelism, specify the INTO TABLE PART clause with an INDDN specification for each partition.

Alternatively, if you cannot enable parallelism, use multiple jobs to run LOAD concurrently against separate partitions. This method also requires that you have a separate input data set for each partition.

If you enable parallelism, allocate extra resources as needed and tune your system to avoid significant performance degradation. Specifically, to benefit from parallel operations when you use LOAD SHRLEVEL CHANGE or parallel inserts, especially when secondary indexes are used, take the following actions:

- Use a larger buffer pool to improve the buffer pool hit ratio.
- Define a higher deferred-write threshold to reduce the number of pages that are written to disk, which reduces the I/O time and contention.
- Define a larger checkpoint interval to reduce the number of pages that are written to disk, which reduces the I/O time and contention.
- Use ESS Parallel Access Volume (PAV) to support multiple concurrent I/Os to the same volume that contains secondary index data sets.
- Use secondary index pieces to support multiple concurrent secondary index I/Os.

- **Use SORTKEYS:** The SORTKEYS option improves performance of the index key sort. With SORTKEYS, index keys are passed in memory rather than written to work files. Avoiding this I/O to the work files improves LOAD performance. LOAD with SORTKEYS also reduces disk space requirements for the SYSUT1 and SORTOUT data sets, especially if you provide an estimate of the number of keys to sort. The SORTKEYS option reduces the elapsed time from the start of the RELOAD phase to the end of the BUILD phase.

  The SORTKEYS option is the default if one of the following conditions is true: SHRLEVEL is not NONE or SHRLEVEL is NONE, and the target table has one or more indexes.

  With SORTKEYS, you can specify an estimate of the number of keys for the job to sort. If the estimate is omitted or specified as 0, LOAD writes the extracted keys to the work data set, which reduces the performance improvement of using SORTKEYS.

  To estimate the number of keys to sort:

  1. Count 1 for each index.
  2. Count 1 for each foreign key where the foreign key and index definitions are not identical.
  3. For each foreign key where the foreign key and index definitions are identical:
     a. Count 0 for the first relationship in which the foreign key participates.
     b. Count 1 for subsequent relationships in which the foreign key participates (if any).
  4. Multiply the count by the number of rows to be loaded.

  If more than one table is being loaded, repeat the preceding steps for each table, and sum the results.
- **Build the indexes in parallel:** You can reduce the elapsed time of a LOAD job for a table space or partition with more than one defined index by having LOAD build the indexes in parallel. See "Building indexes in parallel for LOAD" on page 341.
- **Specify PREFORMAT:** PREFORMAT eliminates the need for DB2 to preformat new pages in a table space during execution time.

  DB2 preformatting sometimes causes a delay, which can affect the performance or execution-time consistency of applications that do many inserts or LOAD jobs with SHRLEVEL CHANGE. When these delays occur and you can predict the

table size for a business processing cycle, consider using LOAD PREFORMAT or REORG PREFORMAT. This technique is valuable only when DB2 preformatting causes a measurable delay with processing or causes inconsistent application elapsed times for INSERT operations or LOAD RESUME YES SHRLEVEL CHANGE jobs.

Recommendation: Assess performance before and after you use LOAD PREFORMAT or REORG PREFORMAT to quantify its value in your environment.

Using PREFORMAT might eliminate execution-time delays but adds setup time before the application's execution. The cost of this improvement is an increase in the LOAD or REORG time, because the utility must preformat all pages between the data that is loaded or reorganized and the high-allocated RBA. The additional LOAD or REORG time that is required depends on the amount of disk space that is being preformatted. When this preformatted space is used and DB2 needs to extend the table space, normal data set extending and preformatting occurs.

Consider using preformatting for LOAD SHRLEVEL CHANGE or INSERT processing in the following situations:

- For tables on which many inserts are done and that receive a predictable amount of data. In this case, all of the required space can be preallocated before the application's execution.
- For a table that acts as a repository for work items that come into a system and that are later used for a backend task that processes the work items.
- For table spaces that start out empty and are populated by many inserts before any query access is run against the table space.

LOAD PREFORMAT or REORG PREFORMAT is not recommended for tables that have a high ratio of reads to inserts if the reads result in table space scans. In this case, preformatting of a table space that contains a table that is used for query processing can cause table space scans to read extra empty pages. This extra reading can extend the elapsed time for these queries.

Mixing inserts and nonindexed queries against a preformatted table space might have a negative impact on the query performance without providing a compensating improvement in the insert performance. Typically, PREFORMAT yields the best results where a high ratio of inserts to read operations exists.

Also, consider the following implications of PREFORMAT on your data sets:

- For user-managed data sets, DB2 does not delete and reallocate them during utility processing. The size of the data set does not shrink back to the original data set allocation size but either remains the same or increases in size if more space or data is added. This characteristic has implications when LOAD or REORG PREFORMAT is used because of the preformatting that is done for all free pages between the high-used RBA (or page) to the high-allocated RBA. This preformatting includes secondary extents that have been allocated.
- For DB2-managed data sets, DB2 deletes and reallocates them if you specify REPLACE on the LOAD or REORG job. This behavior results in the data sets being resized to their original allocation size. They remain that size if the data that is being reloaded does not fill the primary allocation and force a secondary allocation. Therefore, LOAD PREFORMAT or REORG PREFORMAT with DB2-managed data causes at least the full primary allocation amount of a data set to be preformatted after the data is reloaded into the table space.

– For both user-managed and DB2-managed data sets, if the data set goes into secondary extents during utility processing, the high-allocated RBA becomes the end of the secondary extent. That value becomes the high value for preformatting.

Related reference:

"Syntax and options of the LOAD control statement" on page 247

Conversion of input data

The LOAD utility converts data between compatible data types. The source type is used for user-defined distinct types.

The tables shown below identify the compatibility of data types for assignments and comparisons. Y indicates that the data types are compatible. N indicates that the data types are not compatible. D indicates the defaults that are used when you do not specify the input data type in a field specification of the INTO TABLE statement.

The following table shows the compatibility of numeric data types.

Table 42. Compatibility of converting numeric data types.

Input data types	Output data types					
	SMALLINT	BIGINT	INTEGER	DECIMAL	FLOAT	DECFLOAT
SMALLINT	D	Y	Y	Y	Y	Y
BIGINT	Y	D	Y	Y	Y	Y
INTEGER	Y	Y	D	Y	Y	Y
DECIMAL	Y	Y	Y	D	Y[1]	Y[1]
FLOAT	Y	Y	Y	Y	D	Y
DECFLOAT	Y	Y	Y	Y	Y	D

Notes:

1. Loading a DECFLOAT or FLOAT column from a DECIMAL PACKED input field can produce unpredictable results. Instead, use the DECIMAL EXTERNAL format for the input field.

The following table shows the compatibility of character data types.

Table 43. Compatibility of converting character data types.

Input data types	Output data types									
	BLOB	CHAR	VAR-CHAR	CLOB	GRAPHIC	VAR-GRAPHIC	DBCLOB	ROWID	BINARY	VAR-BINARY
CHAR	Y	D	Y	Y	Y[1]	Y[1]	Y[1]	Y	Y	Y
CHAR MIXED	Y	D	Y	Y	Y[1]	Y[1]	Y[1]	N	Y	Y
VARCHAR	Y	Y	D	Y	Y[1]	Y[1]	Y[1]	Y	Y	Y
VARCHAR MIXED	Y	Y	D	Y	Y[1]	Y[1]	Y[1]	N	Y	Y
GRAPHIC	N	Y[1]	Y[1]	Y[1]	D	Y	Y	N	N	N
VAR-GRAPHIC	N	Y[1]	Y[1]	Y[1]	Y	D	Y	N	N	N
ROWID	N	N	N	N	N	N	N	D	N	N
BINARY	Y	N	N	N	N	N	N	N	D	Y
VAR-BINARY	Y	N	N	N	N	N	N	N	Y	D

Note:

1. Conversion applies when either the input data or the target table is Unicode.

The following table shows the compatibility of time data types.

Table 44. Compatibility of converting time data types.

Input data types	Output data types			
	DATE	TIME	TIMESTAMP	TIMESTAMP WITH TIME ZONE
DATE EXTERNAL	D	N	N	N
TIME EXTERNAL	N	D	N	N
TIMESTAMP EXTERNAL	Y	Y	D	Y[1]
TIMESTAMP WITH TIME ZONE EXTERNAL	Y	Y	Y	D

Note:

1. If the data type of the target column is TIMESTAMP WITH TIME ZONE and the timestamp value that is being loaded does not contain a time zone, the LOAD utility uses the value that you specify for the IMPLICIT_TZ option. If you do not specify this option, DB2 uses the value from the IMPLICIT_TIMEZONE DECP value. For more information about this DECP value, see IMPLICIT TIME ZONE field (IMPLICIT_TIMEZONE DECP value) (DB2 Installation and Migration).

Input fields with data types CHAR, CHAR MIXED, CLOB, DBCLOB, VARCHAR, VARCHAR MIXED, GRAPHIC, GRAPHIC EXTERNAL, and VARGRAPHIC are converted from the CCSIDs of the input file to the CCSIDs of the table space when they do not match. For example:

- You specify the ASCII or UNICODE option for the input data, and the table space is EBCDIC.
- You specify the EBCDIC or UNICODE option, and the table space is ASCII.
- You specify the ASCII or EBCDIC option, and the table space is Unicode.
- The CCSID option is specified, and the CCSIDs of the input data are not the same as the CCSIDs of the table space.

CLOB, BLOB, and DBCLOB input field types cannot be converted to any other field type.

Conversion errors cause LOAD:

- To abend, if no discard data set is provided or if the discard limit is exceeded.
- To map the input record for subsequent discarding and continue (if a discard data set is provided)

Truncation of the decimal part of numeric data is not considered a conversion error.

Specifying input fields

You can specify input fields in the LOAD utility control statement.

Procedure

To specify input fields in a LOAD utility control statement:

Take one of the following actions:

- Specify the length of VARCHAR, BLOB, CLOB, DBCLOB, ROWID, VARBINARY, TIMESTAMP, and TIMESTAMP WITH TIME ZONE data in the input file.
- Explicitly define all input field specifications.
- Use DECIMAL EXTERNAL(*length,scale*) in full.
- Specify decimal points explicitly in the input file.

Specifying the TRUNCATE and STRIP options

You can load certain fields that are longer than the length of target column by truncating the data. DB2 truncates the data only when you explicitly specify the TRUNCATE option.

You can specify TRUNCATE with the CHAR, VARCHAR, GRAPHIC, VARGRAPHIC, BINARY, and VARBINARY data type options. LOAD first applies any CCSID conversion, and then truncates the data. The TRUNCATE option of the LOAD utility truncates string data, and it has a different purpose than the SQL TRUNCATE scalar function.

You can also remove a specified character from the beginning, end, or both ends of the data by specifying the STRIP option. This option is valid only with the CHAR, VARCHAR, GRAPHIC, VARGRAPHIC, BINARY, and VARBINARY data type options. If you specify both the TRUNCATE and STRIP options, LOAD performs the strip operation first. For example, if you specify both TRUNCATE and STRIP for a field that is to be loaded into a VARCHAR(5) column, LOAD alters the character strings as shown in the following table. In this table, an underscore represents a character that is to be stripped.

Table 45. Results of specifying both TRUNCATE and STRIP for data that is to be loaded into a VARCHAR(5) column.

Specified STRIP option	Input string	String after strip operation	String that is loaded
STRIP BOTH	'_ABCDEFG_'	'ABCDEFG'	'ABCDE'
STRIP LEADING	'_ABC_'	'ABC_'	'ABC_'
STRIP TRAILING	'_ABC_DEF_'	'_ABC_DEF'	'_ABC_'

How LOAD builds indexes while loading data

LOAD builds all the indexes that are defined for any table that is being loaded.

At the same time the indexes are being built, LOAD checks for duplicate values of any unique index key. If LOAD finds any duplicate values, none of the corresponding rows are loaded. Error messages identify the input records that produce duplicates; optionally, the records are copied to a discard data set. At the end of the job, a summary report lists all errors that are found.

For unique indexes, any two null values are assumed to be equal, unless the index was created with the UNIQUE WHERE NOT NULL clause. In that case, if the key is a single column, it can contain any number of null values, although its other values must be unique.

Neither the loaded table nor its indexes contain any of the records that might have produced an error. Using the error messages, you can identify faulty input records, correct them, and load them again. If you use a discard data set, you can correct the records there and add them to the table with LOAD RESUME.

Building indexes in parallel for LOAD

Parallel index build reduces the elapsed time for a LOAD job by sorting the index keys and rebuilding multiple indexes in parallel, rather than sequentially. Optimally, a pair of subtasks process each index; one subtask sorts extracted keys while the other subtask builds the index.

LOAD begins building each index as soon as the corresponding sort produces its first sorted record.

LOAD uses parallel index build if all of the following conditions are true:

- More than one index needs to be built.
- The LOAD utility statement specifies a non-zero estimate of the number of keys on the SORTKEYS option.
- The number of subtasks that is specified by the PARALLEL option value is not exceeded.

You can either allow the utility to dynamically allocate the data sets that the SORT phase needs, or provide the necessary data sets yourself. Select one of the following methods to allocate sort work and message data sets:

Method 1: LOAD determines the optimal number of sort work and message data sets.

1. Specify the SORTDEVT keyword in the utility statement.
2. Allow dynamic allocation of sort work data sets by **not** supplying SORTWK*nn* DD statements in the LOAD utility JCL.
3. Allocate UTPRINT to SYSOUT.

Method 2: You control allocation of sort work data sets, while LOAD allocates message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Allocate UTPRINT to SYSOUT.

Method 3: You have the most control over rebuild processing; you must specify both sort work and message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Provide DD statements with DD names in the form UTPRIN*nn*.

Using this method does not eliminate the requirement for a UTPRINT DD card.

Data sets used

If you select Method 2 or 3 in the preceding information, use the following information to define the necessary data sets.

Each sort subtask must have its own group of sort work data sets and its own print message data set. Possible reasons to allocate data sets in the utility job JCL rather than using dynamic allocation are:

- To control the size and placement of the data sets
- To minimize device contention
- To optimally use free disk space
- To limit the number of utility subtasks that are used to build indexes

The DD names SW*nn*WK*mm* define the sort work data sets that are used during utility processing. *nn* identifies the subtask pair, and *mm* identifies one or more data sets that are to be used by that subtask pair. For example:

SW01WK01
The first sort work data set that is used by the subtask as it builds the first index.

SW01WK02
The second sort work data set that is used by the subtask as it builds the first index.

SW02WK01
The first sort work data set that is used by the subtask as it builds the second index.

SW02WK02
The second sort work data set that is used by the subtask as it builds the second index.

The DD names UTPRIN*nn* define the sort work message data sets that are used by the utility subtask pairs. *nn* identifies the subtask pair.

Every time you invoke LOAD, new UTPRIN*nn* data sets are dynamically allocated. LOAD does not reuse UTPRIN*nn* data sets from previous job steps. This behavior might cause the available JES2 job queue elements to be consumed more quickly than expected.

Determining the number of sort subtasks

The maximum number of utility subtask pairs that are started for parallel index build is equal to the number of indexes that are to be built.

LOAD determines the number of subtask pairs according to the following guidelines:

- The number of subtask pairs equals the number of sort work data set groups that are allocated.
- The number of subtask pairs equals the number of message data sets that are allocated.
- If you allocate both sort work and message data set groups, the number of subtask pairs equals the smallest number of data sets that are allocated.

Allocation of sort subtasks

The LOAD utility attempts to assign one sort subtask pair for each index that is to be built. If the LOAD utility cannot start enough subtasks to build one index per subtask pair, it allocates any excess indexes across the pairs (in the order that the indexes were created), so that one or more subtask pairs might build more than one index.

During parallel index build processing, LOAD assigns all foreign keys to the first utility subtask pair. Remaining indexes are then distributed among the remaining subtask pairs according to the creation date of the index. If a table space does not participate in any relationships, LOAD distributes all indexes among the subtask pairs according to the index creation date, assigning the first created index to the first subtask pair.

Refer to the following table for conceptual information about subtask pairing when the number of indexes (seven indexes) exceeds the available number of subtask pairs (five subtask pairs).

Table 46. LOAD subtask pairing for a relational table space

Subtask pair	Assigned index
SW01WK*mm*	Foreign keys, fifth created index
SW02WK*mm*	First created index, sixth created index
SW03WK*mm*	Second created index, seventh created index
SW04WK*mm*	Third created index
SW05WK*mm*	Fourth created index

Estimating the sort work file size

If you choose to provide the data sets, you need to know the size and number of keys in all of the indexes that are being processed by the subtask in order to calculate each sort work file size. After you determine which indexes are assigned to which subtask pairs, use one of the following formulas to calculate the required space:

- If the indexes being processed include a mixture of data-partitioned secondary indexes and nonpartitioned indexes, use the following formula: *2 * (longest index key + 15) * (number of extracted keys)*
- Otherwise, if only one type of index is being built, use the following formula: *2 * (longest index key + 13) * (number of extracted keys)*

longest index key
: The length of the longest key that is to be processed by the subtask. For the first subtask pair for LOAD, compare the length of the longest key and the length of the longest foreign key, and use the larger value. For nonpadded indexes, longest index key means the maximum possible length of a key with all varying-length columns, padded to their maximum lengths, plus 2 bytes for each varying-length column.

number of extracted keys
: The number of keys from all indexes that are to be sorted and that the subtask is to process.

Related concepts:

"Parallel index building for REORG TABLESPACE" on page 633

Related tasks:

"Improving LOAD performance" on page 334

How LOAD leaves free space

When it loads data into a nonsegmented table space, the LOAD utility leaves one free page after reaching the FREEPAGE limit. This free page is added regardless of whether the loaded records belong to the same or different tables.

When loading into a segmented table space, LOAD leaves free pages, and free space on each page, in accordance with the current values of the FREEPAGE and PCTFREE parameters. (You can set those values with the CREATE TABLESPACE, ALTER TABLESPACE, CREATE INDEX, or ALTER INDEX statements.) LOAD leaves one free page after reaching the FREEPAGE limit for each table in the table space.

For XML table spaces, FREEPAGE and PCTFREE are not processed until the first REORG.

Loading with RECOVER-pending, REBUILD-pending, or REORG-pending status

You cannot load records by specifying RESUME YES if any partition of a table space is in the RECOVER-pending status. In addition, you cannot load records if any index on the table that is being loaded is in the REBUILD-pending status.

If you are replacing a partition, these preceding restrictions are relaxed; the partition that is being replaced can be in the RECOVER-pending status, and its corresponding index partition can be in the REBUILD-pending status. However, all secondary indexes must **not** be in the page set REBUILD-pending status and KEEPDICTIONARY must not have been specified on active compressed partitions.

The one RECOVER-pending restrictive status has the following description:

RECP RECOVER-pending status is set on a table space or partition. If a single logical partition is in RECP status, the partition is treated as RECP status for SQL access. A single logical partition in RECP status does not restrict utility access to other logical partitions that are not in RECP status. RECP status is reset by recovering only the single logical partition.

The four REBUILD-pending restrictive states have the following descriptions:

RBDP REBUILD-pending status is set on a physical or logical index partition. The individual physical or logical partition is inaccessible and must be rebuilt by using the REBUILD INDEX utility, or recovered by using the RECOVER utility.

PSRBD
Page set REBUILD-pending is set on nonpartitioned secondary indexes. Partitioned indexes, including data-partitioned secondary indexes, are never placed in a page set REBUILD-pending status. The entire index space is inaccessible until you rebuild it with the REBUILD utility, or recover it with the RECOVER utility.

RBDP*
REBUILD-pending star status is set only on logical partitions of nonpartitioning indexes. The entire index is inaccessible, but it is made available again when the affected partitions are rebuilt by using the REBUILD INDEX utility, or recovered by using the RECOVER utility.

The one REORG-pending restrictive status has the following description:

REORP
REORG-pending status indicates that a table space or partition needs to be reorganized.

Related concepts:

"Resetting the REBUILD-pending status" on page 451

Exit procedures

Any field procedure that is associated with a column of a table that is being loaded is executed to encode the data before it is loaded. The field procedures for all columns are executed before any edit or validation procedure for the row.

Any field specification that describes the data is checked before a field procedure is executed. That is, the field specification must describe the data as it appears in the input record.

Loading ROWID columns

Columns that are defined as ROWID can be designated as input fields; refer to the LOAD field specification syntax diagram. LOAD PART is not allowed if the ROWID column is part of the partitioning key. In this situation, DB2 issues error message DSNU256I.

Columns that are defined as ROWID can be designated as GENERATED BY DEFAULT or GENERATED ALWAYS. With GENERATED ALWAYS, DB2 always generates a row ID.

ROWID generated by default

The LOAD utility can set from input data columns that are defined as ROWID GENERATED BY DEFAULT. The input field must be specified as a ROWID. No conversions are allowed. The input data for a ROWID column must be a unique, valid value for a row ID. If the value of the row is not unique, a duplicate key violation occurs. If such an error occurs, the load fails. In this case, you need to discard the duplicate value and re-run the LOAD job with a new unique value, or allow DB2 to generate the value of the row ID.

You can use the DEFAULTIF attribute with the ROWID keyword. If the condition is met, the column is loaded with a value that is generated by DB2. You cannot use the NULLIF attribute with the ROWID keyword because row ID columns cannot be null.

Row change timestamp generated always

The row change timestamp column that is defined as GENERATED ALWAYS cannot be included in the field specification list unless you specify IGNOREFIELDS YES, because DB2 generates the timestamp value for this column.

Loading a LOB column

LOB columns are treated by the LOAD utility as varying-length data. The length value for a LOB column must be 4 bytes.

Procedure

To load a LOB column:

Take one of the following actions:

- **Load the LOB value directly from the input data set:** To load a LOB value directly from the input data set:
  1. In the input data set, include the LOB value preceded by a 4-byte binary field that contains the length of the LOB.
  2. Specify CLOB, BLOB, or DBCLOB in the field specification portion of the LOAD statement. These options indicate that the field in the input data set is a LOB value. For example, to load a CLOB into the RESUME column, specify something like `RESUME POSITION(7) CLOB`. This specification indicates that

position 7 of the input data set contains the length of the CLOB followed by the CLOB value that is to be loaded into the RESUME column.

3. If the input record is in spanned record format, specify FORMAT SPANNED YES and specify the LOB fields at the end of the field specification list.

- **Load the LOB value from a file that is listed in the input data set:** When you load a LOB value from a file, the LOB value can be greater than 32 KB. To load a LOB value from a file:
  1. In the input data set, specify the names of the files that contain the LOB values. Each file can be either a PDS, PDSE, or an HFS file.
  2. Specify either BLOBF, CLOBF, or DBCLOBF in the field specification portion of the LOAD statement. For example, to load a LOB into the RESUME column of a table, specify something like `RESUME POSITION(7) VARCHAR CLOBF`. This specification indicates that position 7 of the input data set contains the name of a file from which a varying-length CLOB is to be loaded into the RESUME column.
  3. To insert an empty LOB value into a LOB column, specify one of the following items in the LOAD statement:
     - A blank file name for CHAR CLOBF, CHAR BLOBF, or CHAR DBCLOBF
     - A blank file name for VARCHAR CLOBF, VARCHAR BLOBF, or VARCHAR DBCLOBF
     - A file name with length 0 for VARCHAR CLOBF, VARCHAR BLOBF, or VARCHAR DBCLOB

     Each of these items tell the LOAD utility that the LOB is empty, and the LOAD utility does insert it into the auxiliary table space. LOAD uses a column indicator to indicate that the LOB is empty.

     This step assumes that the LOB is not NULL.
- **Load data from another table:** To transfer data from one location to another location or from one table to another table at the same location, use a cursor. This method of loading data is called the cross-loader function.

  When you use the cross-loader function, the LOB value can be greater than 32 KB. For this method, DB2 uses a separate buffer for LOB data and therefore stores only 8 bytes per LOB column. The sum of the lengths of the non-LOB columns plus the sum of 8 bytes per LOB column cannot exceed 32 KB.

Related tasks:

"Loading data by using the cross-loader function" on page 331

LOAD LOG on a LOB table space

A LOB table space that is defined with LOG YES or LOG NO affects logging during the load of a LOB column.

The following table shows the logging output and LOB table space effect, if any.

Table 47. LOAD LOG and REORG LOG impact for a LOB table space

LOAD LOG/ REORG LOG keyword	LOB table space LOG attribute	What is logged	LOB table space status after utility completes
LOG YES	LOG YES	Control information and LOB data	No pending status
LOG YES	LOG NO	Control information	No pending status
LOG NO	LOG YES	Nothing	COPY-Pending[1]
LOG NO	LOG NO	Nothing	COPY-Pending[1]

Table 47. LOAD LOG and REORG LOG impact for a LOB table space (continued)

LOAD LOG/ REORG LOG keyword	LOB table space LOG attribute	What is logged	LOB table space status after utility completes

Note:

1. REORG LOG NO of a LOB table space requires SHRLEVEL REFERENCE, which requires that an inline copy be taken during the REORG. This means that you never set COPY-pending for REORG of LOB table spaces under any circumstances

Loading an XML column

XML columns are treated by the LOAD utility as varying-length data. The length value for an XML column must be 2 bytes.

About this task

LOAD performance can be improved if the input data is in binary XML format.

Procedure

To load an XML column:

Use one of the following approaches:

- **Load the XML value directly from the input data set:** To load an XML value directly from the input data set:
  1. In the input data set, include the XML value preceded by a 2-byte binary field that contains the length of the XML column.
  2. When loading directly from an input record, you must specify XML as the input field type. This is the only acceptable input field type for loading XML column from input record. For example, to load a data into the RESUME column which is XML, specify something like `RESUME POSITION(7) XML`. This specification indicates that position 7 of the input data set contains the length of the XML followed by the XML value that is to be loaded into the RESUME column.

     If the input data is in Extensible Dynamic Binary XML DB2 Client/Server Binary XML Format (binary XML format), you need to specify XML BINARYXML as the input field type.
  3. If the input record is in spanned record format, specify FORMAT SPANNED YES and specify the XML fields at the end of the field specification list.
- **Load the XML value from a file that is listed in the input data set:** When you load an XML value from a file, the XML value can be greater than 32 KB. To load an XML value from a file:
  1. In the input data set, specify the name of the file that contains the value to be loaded to the XML column. The file name can be a PDS, PDSE or a HFS file.
  2. Specify either BLOBF, CLOBF, or DBCLOBF in the field specification portion of the LOAD statement. For example, to load a CLOB file into an XML column RESUME, specify something like `RESUME POSITION(7) VARCHAR CLOBF`. This specification indicates that position 7 of the input data set contains the name of a file from which a varying-length CLOB is to be loaded into the RESUME column.

If the input data is in binary XML format, you need to specify BLOBF BINARYXML in the field specification.

3. When data loaded into an XML column that has an XML type modifier, LOAD validates the input data according to the XML schema that is specified in the type modifier. If LOAD detects a violation, it deletes the row and issues a message to identify the violation.

Related concepts:

Best practices for XML performance in DB2 (DB2 Performance)

LOAD LOG on an XML table space

An XML table space that is defined with LOG YES or LOG NO affects logging during the load of an XML column.

The following table shows the logging output and XML table space effect, if any.

Table 48. LOAD LOG impact for an XML table space

LOAD LOG keyword	XML table space LOG attribute	What is logged	XML table space status after utility completes
LOG YES	LOG YES	Data	No pending status
LOG YES	LOG NO	Nothing	No pending status
LOG NO	LOG YES	Nothing	COPY-Pending
LOG NO	LOG NO	Nothing	ICOPY-Pending

Running LOAD RESUME YES SHRLEVEL CHANGE without logging

If you run the LOAD utility with the RESUME YES SHRLEVEL CHANGE options, you can improve the performance by limiting the logging that is done by DB2 during the LOAD operation.

Procedure

To run LOAD RESUME YES SHRLEVEL CHANGE without logging:

1. Alter the table space to NOT LOGGED.
2. Run the LOAD job with the RESUME YES SHRLEVEL CHANGE options.

   If the LOAD job fails, you cannot restart it, because the target is a NOT LOGGED table space. Instead terminate the job, recover the data from a previous image copy, and rerun the LOAD job.
3. Alter the table space back to LOGGED.
4. Take an image copy of the table space.

Related concepts:

The NOT LOGGED attribute (DB2 Administration Guide)

Related tasks:

Changing the logging attribute (DB2 Administration Guide)

Related reference:

ALTER TABLESPACE (DB2 SQL)

Collecting inline statistics while loading a table

If you do not specify LOAD RESUME YES, you can use the STATISTICS keyword to gather inline statistics. In most cases, using the STATISTICS keyword eliminates the need to run RUNSTATS after loading a table space.

However, if you perform a LOAD PART operation, you should run RUNSTATS INDEX on the nonpartitioned secondary indexes to update the catalog data about these indexes.

Procedure

To collect statistics while loading a table:

1. Use the STATISTICS option to collect statistics so that the DB2 catalog statistics contain information about the newly loaded data:

Option	Description
Collecting inline statistics for discarded rows	If you specify the DISCARDDN option when you collect inline statics and a row is found with check constraint errors or conversion errors, the row is not loaded into the table. However, the LOAD utility collects inline statistics before it identifies the rows to discard. As a general rule, if the number of discarded rows is larger than 20 percent of the total number of rows in the table, , run the RUNSTATS utility separately on the table after running LOAD.
Collecting inline statistics for data partitioned secondary indexes	To collect inline statistics on data partitioned secondary indexes, you must allocate sort work data sets.

   If you perform a LOAD operation on a base table that contains an XML column, DB2 does not collect inline statistics for the related XML table space or its indexes. Recording these new statistics enables DB2 to select SQL paths with accurate information.
2. Rebind any application plans that depend on the loaded tables to update the path selection of any embedded SQL statements.

What to do next

To collect statistics on the loaded table, you might need to invoke the RUNSTATS utility after the LOAD utility processing has completed.

Related tasks:

Maintaining statistics in the catalog (DB2 Performance)

Reducing the cost of collecting statistics (DB2 Performance)

Collecting statistics by using DB2 utilities (DB2 Performance)

Related reference:

"Data sets that LOAD uses" on page 304

Chapter 20, "LOAD," on page 245

Inline COPY for a base table space

If you take an inline image copy of a table that has LOB columns, DB2 makes a copy of the base table space, but does not copy the LOB table spaces.

Termination of LOAD

You can terminate a LOAD utility job.

If you terminate LOAD by using the TERM UTILITY command during the reload phase, the records are not erased. The table space remains in RECOVER-pending status, and indexes remain in the REBUILD-pending status.

If you terminate LOAD by using the TERM UTILITY command during the sort or build phases, the indexes that are not yet built remain in the REBUILD-pending status.

If you terminate a LOAD SHRLEVEL CHANGE, uncommitted records are rolled back, but committed records remain in the table. The table space is not in RECOVER-pending status, and the indexes are not in REBUILD-pending status.

If the LOAD job terminates during the RELOAD, SORT, BUILD, or SORTBLD phases, both RESTART and RESTART(PHASE) phases restart from the beginning of the RELOAD phase. However, restart of LOAD RESUME YES or LOAD PART RESUME YES in the BUILD or SORTBLD phase results in message DSNU257I.

The following table lists the LOAD phases and their effects on any pending states when the utility is terminated in a particular phase.

Table 49. LOAD phases and their effects on pending states when terminated.

Phase	Effect on pending status
Reload	• Places table spaces in RECOVER-pending status, and then resets the status if there are no unique indexes. • Places indexes in REBUILD-pending status. • Places table spaces in COPY-pending status if there are no unique indexes. • Places table spaces in CHECK-pending status.
Build	• Resets REBUILD-pending status for non-unique indexes. • Resets RECOVER-pending status for table spaces with unique indexes, if no INDEXVAL phase is needed. • Places table spaces in COPY-pending status.
Indexval	• Resets REBUILD-pending status for unique indexes. • Resets RECOVER-pending status for table spaces with unique indexes. • Places table spaces in COPY-pending status.
Enforce	• Resets CHECK-pending status for table spaces.

Restart of LOAD

You can restart a LOAD utility job.

You can restart the job either at its last commit point (RESTART(CURRENT)) or at the beginning of the phase during which operation ceased (RESTART(PHASE)). LOAD output messages identify the completed phases. Use the DISPLAY command to identify the specific phase during which operation stopped.

By default, DB2 uses RESTART(CURRENT), except if LOAD is restarting during the UTILINIT phase or the UTILTERM phase. In both of these situations, DB2 uses RESTART(PHASE) by default. You can override the default RESTART values by using the RESTART parameter.

Restrictions: The following restrictions apply to restarting LOAD jobs:

- If LOAD abnormally terminates or a system failure occurs while LOAD is in the UTILTERM phase, you must restart with RESTART(PHASE).
- If you restart a LOAD job with the RESUME YES and SORTKEYS NO options for a table that has LOB columns, you must use RESTART(CURRENT).
- If you use RESTART(PHASE) to restart a LOAD job that specified RESUME NO, the LOB table spaces and indexes on auxiliary tables are reset.
- For a table that has LOB columns, you cannot restart a LOAD job that uses the INCURSOR option.
- If you restart a LOAD job that uses the STATISTICS keyword, inline statistics collection does not occur. To update catalog statistics, run the RUNSTATS utility after the restarted LOAD job completes.
- If you are using a BatchPipes file, you cannot restart the LOAD utility. If the application that populates the BatchPipes file terminates, you need to terminate the job where LOAD is running. If the LOAD utility was invoked from a stored procedure, you also need to terminate the WLM application environment of the LOAD utility that reads the BatchPipes file. After you terminate the job, terminate the LOAD utility by using the DB2 TERM UTILITY command, and then you can resubmit the LOAD job.
- You cannot restart LOAD with RESUME and with PRESORTED YES in the RELOAD phase. If you do so, utility processing abnormally terminates, and LOAD issues an error message. You must:
  - Terminate LOAD
  - Recover the table space that is being loaded
  - Recover all indexes on the table space that are in the REBUILD-pending state
- If the LOAD statement includes the PARALLEL option with a value other than 1, you cannot use RESTART(CURRENT); RESTART(PHASE) is used instead.

The following table provides information about restarting LOAD, depending on the phase that LOAD was in when the job stopped. The TYPE column distinguishes between the effects of specifying RESTART or RESTART(PHASE). Additional phase restrictions are explained in the notes.

Table 50. LOAD restart information

Phase	Type of RESTART	Required data sets	Notes
RELOAD	CURRENT	SYSREC and SYSUT1 SYSMAP and SYSERR	1, 2, 10
	PHASE	SYSREC	3, 10, 11
SORT	CURRENT	SYSUT1	4, 10
	PHASE	SYSUT1	10
BUILD	CURRENT	SORTOUT	4, 5, 10
	PHASE	SORTOUT	5, 10
SORTBLD	CURRENT	SYSUT1 and SORTOUT	5, 6, 10
	PHASE	SYSUT1 and SORTOUT	5, 6, 10

Table 50. LOAD restart information (continued)

Phase	Type of RESTART	Required data sets	Notes
INDEXVAL	CURRENT	SYSERR or SYSUT1	2
	PHASE	SYSERR or SYSUT1	2
ENFORCE	CURRENT	SORTOUT and SYSUT1	7
	PHASE	SORTOUT and SYSUT1	7
DISCARD	CURRENT	SYSMAP and SYSERR SORTOUT and SYSUT1	7, 8
	PHASE	SYSMAP and SYSERR SORTOUT and SYSUT1	7, 8
REPORT	CURRENT	SYSERR or SORTOUT SYSMAP and SYSERR	7, 9
	PHASE	SYSERR or SORTOUT SYSMAP and SYSERR	7, 9

Note:

1. SYSMAP and SYSERR data sets might not be required for all LOAD jobs.
2. If the SYSERR data set is not required and not provided, LOAD uses SYSUT1 as a work data set to contain error information.
3. You must not restart during the RELOAD phase if you specified SYSREC DD *. This statement prevents internal commits from being taken, and RESTART performs like RESTART(PHASE), except without data back out. Also, you must not restart if your SYSREC input consists of multiple concatenated data sets.
4. The utility can be restarted with either RESTART or RESTART(PHASE). However, because this phase does not take checkpoints, RESTART is always re-executed from the beginning of the phase.
5. A LOAD RESUME YES job cannot be restarted in the BUILD or SORTBLD phase.
6. Use RESTART or RESTART(PHASE) to restart at the beginning of the RELOAD phase.
7. This utility can be restarted with either RESTART or RESTART(PHASE). However, the utility can be re-executed from the last internal checkpoint. This behavior is dependent on the data sets that are used and whether any input data sets were rewritten.
8. The SYSUT1 data set is required if the target table space is segmented or partitioned.
9. If a report is required and this LOAD job does not specify discard processing, SYSMAP is required to complete the report phase.
10. Any job that finished abnormally in the RELOAD, SORT, BUILD, or SORTBUILD phase and has SORTKEYS enabled restarts from the beginning of the RELOAD phase. (A job that has SORTKEYS enabled means that in the LOAD statement, SORTKEYS was either explicitly specified with a valid value or implicitly specified as the default. In other words, SORTKEYS NO was not specified.)
11. LOAD with RESUME and with PRESORTED YES cannot be restarted in the RELOAD phase.

Related tasks:

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Related reference:

-DISPLAY UTILITY (DB2) (DB2 Commands)

After running LOAD

You can perform certain activities after you run the LOAD utility.

Copying the loaded table space or partition

If you ran the LOAD utility with the LOG YES option, consider taking a full image copy of the table space or partition that you loaded. Such a copy might reduce the processing time of subsequent recovery operations.

About this task

If you took primary and backup inline copies during the load operation, you do not need to take full image copies of the table space or partition after LOAD completes. However, you might need to take images copies of indexes.

Procedure

To copy the loaded table space or partition:

Use the COPY utility to create a full image copy. If you specified the RESUME NO option or the REPLACE option for LOAD, take two or more full image copies.

Related concepts:

"Full image copies" on page 159

Related tasks:

"How to use inline COPY with LOAD" on page 332

Related reference:

Chapter 15, "COPY," on page 139

Resetting restricted status after running the LOAD utility

The LOAD utility can place a table space or an index space into a restricted status. Several types of restricted status are possible.

Before you begin

You can issue the following command to discover which spaces are in a restricted status:

```
-DISPLAY DATABASE (*) SPACENAM (*) RESTRICT
```

About this task

Your use of a table space in restricted status is severely limited. In general, you cannot access the data through SQL. You can only drop the table space or one of its tables, or perform some operation that resets the status.

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

-DISPLAY DATABASE (DB2) (DB2 Commands)

Resetting COPY-pending status

If you load with LOG NO and do not take an inline copy, LOAD places a table space in the COPY-pending status. Immediately after that operation, DB2 cannot recover the table space (although you can, by loading it again).

Prepare for recovery, and turn off the restriction, by making a full image copy using SHRLEVEL REFERENCE. (If you end the copy job before it is finished, the table space is still in COPY-pending status.)

You can also remove the restriction by using one of these operations:
- LOAD REPLACE LOG YES
- LOAD REPLACE LOG NO with an inline copy
- REORG LOG YES
- REORG LOG NO with an inline copy
- REPAIR SET with NOCOPYPEND

If you use LOG YES and do not make an image copy of the table space, subsequent recovery operations are possible but take longer than if you had made an image copy.

A table space that is in COPY-pending status can be read without restriction; however, it cannot be updated.

Resetting REBUILD-pending status

LOAD sets index spaces to REBUILD-pending status when a REBUILD job ends before the INDEXVAL phase is complete.

LOAD places all the index spaces for a table space in the REBUILD-pending status if you end the job (by using the TERM UTILITY command) before it completes the INDEXVAL phase. DB2 places the table space in RECOVER-pending status if you end the job before the job completes the RELOAD phase.

Resetting the RECOVER-pending status depends on when the utility terminated:
- If the data is intact and you have a full image copy of the affected indexes, you can recover the indexes using the RECOVER INDEX utility. Run the DISPLAY DATABASE command and examine the output. Data is intact when the output indicates that the indexes are in REBUILD-pending status and the table space is not in RECOVER-pending status. If you do not have an image copy available, you must rebuild the entire index by using the REBUILD INDEX utility. However, for partitioning indexes and for secondary indexes that are in REBUILD-pending (RBDP) status, you can use the PART option of REBUILD INDEX to rebuild separate partitions of the index.
- If the data is not intact, you can either load the table again or recover it to a prior point of consistency. Run the DISPLAY DATABASE command and examine the output. The recovery puts the table space into COPY-pending status and places all indexes in REBUILD-pending status.

CHECK-pending status after running LOAD

The LOAD utility places a table space in CHECK-pending (CHKP) status if its referential integrity is in doubt or its check constraints are violated.

To reset this status, run the CHECK DATA utility, which locates invalid data and, optionally, removes it. If CHECK DATA removes the invalid data, the remaining data satisfies all check and referential constraints and therefore, the CHECK-pending restriction is removed.

Although CHECK DATA is usually the preferred method for resetting CHECK-pending status, you can also reset this status by using any of the following operations:
- Drop tables that contain invalid rows.
- Replace the data in the table space by using LOAD REPLACE and enforcing check and referential constraints.
- Recover all members of the table space that were set to a prior quiesce point.
- Use the REPAIR utility with the SET STATEMENT and NOCHECKPEND option.

Example of CHKP status after LOAD REPLACE

Suppose that you replace the contents of the sample project table (PROJ) by using LOAD with the REPLACE option. You also specify that LOAD is to enforce the table's referential and table check constraints. When the LOAD job completes, the project table contains only valid records and is not in CHECK-pending status. However, its dependent table, the project activity table (PROJACT), is placed in CHECK-pending status. Some of its rows might have project numbers that no longer exist in the project table. (If the project table had any other dependents, they also would be in CHECK-pending status.)

In this case, run CHECK DATA against the table space that contains the project activity table to reset the status. When you run CHECK DATA, ensure that all related table spaces are available. Related table spaces means all table spaces that contain either parent tables or dependent tables of any table in the table space that is being checked.

Also, in the CHECK DATA statement, consider the value that you specify for the DELETE option as follows:

YES
DELETE YES deletes invalid records and resets the status, but it is not the default value. If you specify DELETE YES, you use another table that is called an exception table to receive copies of the invalid records. For example, if table Y is the exception table for table X, name it with the following clause in the CHECK DATA statement:

```
FOR EXCEPTION IN X USE Y
```

Deletes by CHECK DATA are not subject to any of the SQL delete rules; they cascade without restraint to the lowest-level descendant. Therefore, if you use DELETE YES, you must name an exception table for every descendant of every table in every table space that is being checked.

NO Use DELETE NO, the default value, to quickly determine the size of the problem. If many rows are affected, you can choose to correct the problem by reloading the data rather than using CHECK DATA to correct the current situation.

Example:

In the following example, CHECK DATA is to be run against the table space that contains the project activity table (PROJACT). Assume that the exception tables DSN8B10.EPROJACT and DSN8B10.EEPA exist.

```
CHECK DATA TABLESPACE DSN8D11A.PROJACT
   DELETE YES
   FOR EXCEPTION IN DSN8B10.PROJACT USE DSN8B10.EPROJACT
                 IN DSN8B10.EMPPROJACT USE DSN8B10.EEPA
   SORTDEVT SYSDA
   SORTNUM 4
```

If the statement does not name error or work data sets, the JCL for the job must contain DD statements similar to the following DD statements:

```
//SYSERR   DD UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT DD UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//UTPRINT DD SYSOUT=A
```

Example of CHKP status after LOAD RESUME

Suppose that you want to add records to both the sample project (PROJ) and project activity (PROJACT) tables by using LOAD with the RESUME option. Furthermore, you want to run both jobs at the same time, which you can do because the tables belong to separate table spaces. When you load the project activity table, you must use the ENFORCE NO option in the LOAD statement because you cannot assume that the parent project table is already loaded.

After the two jobs are complete, the table spaces are in the following states:

- If you enforced constraints when loading the project table, the table space is not in CHECK-pending status.
- Because you did not enforce constraints on the project activity table, the table space is in CHECK-pending status.
- Because you used LOAD RESUME (not LOAD REPLACE) when loading the project activity table, its dependents (the employee-to-project-activity table) are not in CHECK-pending status. That is, the LOAD operation did not delete any parent rows from the project activity table, and therefore cannot violate the referential integrity of its dependent.

Therefore, you should run CHECK DATA on the project activity table. If you specify DELETE YES, you need an exception table for PROJACT and an exception table for EMPPROJACT, which is dependent on PROJACT.

To speed CHECK DATA processing, specify the SCOPE PENDING option to limit the checking.

DB2 records the identifier of the first row of the table that might violate referential or table check constraints. For partitioned table spaces, that identifier is in SYSIBM.SYSTABLEPART; for nonpartitioned table spaces, that identifier is in SYSIBM.SYSTABLES.

Example:

In the following example, CHECK DATA is to be run against the table space that contains the project activity table after LOAD RESUME:

```
CHECK DATA TABLESPACE DSN8D11A.PROJACT
   SCOPE PENDING
   DELETE YES
   FOR EXCEPTION IN DSN8B10.PROJACT USE DSN8B10.EPROJACT
                 IN DSN8B10.EMPPROJACT USE DSN8B10.EEPA
   SORTDEVT SYSDA
   SORTNUM 4
```

As before, the JCL for the job needs DD statements to define the error and sort data sets.

Related reference:

"CHECK-pending status" on page 1105

"Syntax and options of the CHECK DATA control statement" on page 80

"Exception tables for the CHECK DATA utility" on page 98

"Data sets that CHECK DATA uses" on page 92

Project table (DSN8B10.PROJ) (Introduction to DB2 for z/OS)

Project activity table (DSN8B10.PROJACT) (Introduction to DB2 for z/OS)

Relationships among the sample tables (Introduction to DB2 for z/OS)

Running CHECK INDEX after loading a table that has indexes

The CHECK INDEX utility tests whether an index is consistent with the data it indexes and issues error messages if it finds an inconsistency.

About this task

If you have any reason to doubt the accuracy of an index (for example, if the result of an SQL SELECT COUNT statement is inconsistent with RUNSTATS output) you might want to check the index.

Procedure

To check the accuracy of the index:

Invoke the CHECK INDEX utility. You might also want to invoke the CHECK INDEX utility after any LOAD operation that shows some abnormal condition in its execution, or even run it periodically to verify the accuracy of important indexes.

What to do next

To rebuild an index that is inconsistent with its data, Invoke the REBUILD INDEX utility.

Related reference:

Chapter 13, “CHECK INDEX,” on page 109

Chapter 26, “REBUILD INDEX,” on page 427

Chapter 33, “RUNSTATS,” on page 737

COUNT (DB2 SQL)

Recovering data after a failed LOAD job

If a LOAD utility job fails, you can recover the data to a point in time before the LOAD job ran.

About this task

When you specify LOG YES in the LOAD utility control statement, DB2 inserts a record into the SYSIBM.SYSCOPY catalog table at the beginning of the RELOAD phase of LOAD processing. DB2 uses this SYSCOPY record to help facilitate recovery in case of failure. However, because of this SYSCOPY record, if the LOAD LOG YES job fails, recover to the point in time before the LOAD job was run. Although you can recover the data to the current state, the results are unpredictable.

Procedure

To recover a failed LOAD job, take one of the following actions:

- If the LOAD statement included the LOG YES option, recover the data to a point in time before the LOAD job ran. You can use the RECOVER utility with the TORBA option or another point-in-time recovery option.
- If the LOAD statement included the LOG NO option, recover the data to the point in time before the LOAD job ran or to the current state.

Related concepts:

"Point-in-time recovery" on page 494

Options for restoring data to a prior point in time (DB2 Administration Guide)

Related reference:

SYSIBM.SYSCOPY table (DB2 SQL)

Reorganization of an auxiliary index after LOAD

Indexes on the auxiliary tables are not built during the BUILD phase. Instead, LOB values are inserted (not loaded) into auxiliary tables during the RELOAD phase as each row is loaded into the base table. Each index on the auxiliary table is also updated as part of the insert operation.

Because the LOAD utility inserts keys into an auxiliary index, free space within the index might be consumed and index page splits might occur. Consider reorganizing an index on the auxiliary table after LOAD completes to introduce free space into the index for future inserts and loads.

Effects of running LOAD

The effects of running LOAD can be different, depending on your situation. Running the LOAD utility can have effects on index version numbers, control intervals, and table spaces that are defined with the NOT LOGGED attribute.

The effect of LOAD on index version numbers

DB2 stores the range of used index version numbers in the OLDEST_VERSION and CURRENT_VERSION columns of the following catalog tables:

- SYSIBM.SYSINDEXES
- SYSIBM.SYSINDEXPART

The OLDEST_VERSION column contains the oldest used version number, and the CURRENT_VERSION column contains the current version number.

When you run LOAD with the REPLACE option, the utility updates this range of used version numbers for indexes that are defined with the COPY NO attribute. LOAD REPLACE sets the OLDEST_VERSION column to the current version number, which indicates that only one version is active; DB2 can then reuse all of the other version numbers.

Recycling of version numbers is required when all of the version numbers are being used. All version numbers are being used when one of the following situations is true:

- The value in the CURRENT_VERSION column is one less than the value in the OLDEST_VERSION column.
- The value in the CURRENT_VERSION column is 15, and the value in the OLDEST_VERSION column is 0 or 1.

You can also run REBUILD INDEX, REORG INDEX, or REORG TABLESPACE to recycle version numbers for indexes that are defined with the COPY NO attribute. To recycle version numbers for indexes that are defined with the COPY YES attribute or for table spaces, run MODIFY RECOVERY.

The effect of LOAD REPLACE on the control interval

When you run a LOAD job with the REPLACE option but without the REUSE option and the data set that contains the data is DB2-managed, DB2 deletes this data set before the LOAD and redefines a new data set with a control interval that matches the page size.

The effect of LOAD on table spaces defined with NOT LOGGED attribute

The following table shows the effect of LOAD table spaces defined with the NOT LOGGED attribute

Table 51. LOAD parameters

LOAD REORG LOG keyword	Table space logging attribute	Table space type	What is logged	Table space status after utility completes
LOG YES	NOT LOGGED	Non-LOB	LOG YES changes to LOG NO	No pending status or ICOPY-pending[1]
LOG YES	NOT LOGGED	LOB	control information	No pending status
LOG NO	NOT LOGGED	Non-LOB	nothing	No pending status or ICOPY-pending[1]
LOG NO	NOT LOGGED	LOB	nothing	No pending status

Note:

1. The table space is set to ICOPY-pending status if the records are discarded and no pending status if the records are not discarded.

Related concepts:

Table space versions (DB2 Administration Guide)

Sample LOAD control statements

Use the sample control statements as models for developing your own LOAD control statements.

Example 1: Specifying field positions

The control statement specifies that the LOAD utility is to load the records from the data set that is defined by the SYSREC DD statement into table DSN8810.DEPT. SYSREC is the default input data set.

Each POSITION clause specifies the location of a field in the input record. In this example, LOAD accepts the input that is shown in Figure 28 on page 360 and interprets it as follows:

- The first 3 bytes of each record are loaded into the DEPTNO column of the table.
- The next 36 bytes, including trailing blanks, are loaded into the DEPTNAME column.

  If this input column were defined as VARCHAR(36), the input data would need to contain a 2-byte binary length field preceding the data. This binary field would begin at position 4.
- The next three fields are loaded into columns that are defined as CHAR(6), CHAR(3), and CHAR(16).

The RESUME YES clause specifies that the table space does not need to be empty; new records are added to the end of the table.

```
LOAD DATA
 RESUME YES
 INTO TABLE DSN8B10.DEPT
 (DEPTNO    POSITION (1:3)     CHAR(3),
    DEPTNAME POSITION (4:39)    CHAR(36),
    MGRNO     POSITION (40:45)   CHAR(6),
    ADMRDEPT POSITION (46:48)   CHAR(3),
    LOCATION POSITION (49:64)   CHAR(16))
```

Figure 27. Example of a LOAD statement that specifies field positions

Figure 28. shows the input to the preceding LOAD job.

```
A00SPIFFY COMPUTER SERVICE DIV.        000010A00USIBMSTODB21
B01PLANNING                            000020A00USIBMSTODB21
C01INFORMATION CENTER                  000030A00USIBMSTODB21
D01DEVELOPMENT CENTER                        A00USIBMSTODB21
```

Figure 28. Records in an input data set for LOAD

The following table shows the result of executing the statement SELECT * FROM DSN8B10.DEPT after the preceding input records are loaded.

Table 52. Data that is loaded into a table

DEPTNO	DEPTNAME	MGRNO	ADMRDEPT	LOCATION
A00	SPIFFY COMPUTER SERVICE DIV.	000010	A00	USIBMSTODB21
B01	PLANNING	000020	A00	USIBMSTODB21
C01	INFORMATION CENTER	000030	A00	USIBMSTODB21
D01	DEVELOPMENT CENTER		A00	USIBMSTODB21

Example 2: Replacing data in a given partition

The following control statement specifies that data from the data set that is defined by the SYSREC DD statement is to be loaded into the first partition of table DSN8810.DEPT. The default input data set is SYSREC. The REPLACE option indicates that the input data is to replace only the specified partition. If the REPLACE option was specified before the PART option, REPLACE would indicate that entire table space is to be replaced, and the data is to be loaded into the specified partition. Note that the keyword DATA does not need to be specified.

```
LOAD
  INTO TABLE DSN8B10.DEPT PART 1 REPLACE
```

Example 3: Loading selected records into multiple tables

The control statement in specifies that the LOAD utility is to load certain data from the EMPLDS input data set into tables DSN8B10.EMP, SMITH.EMPEMPL, and DSN8810.DEPT. The input data set is identified by the INDDN option. The WHEN clauses indicate which records are to be loaded into each table. For the EMP and DEPT tables, the utility is to load only records that begin with the string LKA. For the EMPEMPL table, the utility is to load only records that begin with the string ABC. The RESUME YES option indicates that the table space does not need to be

empty for the LOAD job to proceed. The new rows are added to the end of the tables. This example assumes that the first two tables being loaded have exactly the same format, and that the input data matches that format; therefore, no field specifications are needed for those two INTO TABLE clauses. The third table has a different format, so field specifications are required and are supplied in the example.

The three tables being loaded each contain a different number of records. To improve the sizing of the sort work data sets that the LOAD utility requires, the number of records being loaded into each table is specified on the NUMRECS keyword for each table.

The POSITION clauses specify the location of the fields in the input data for the DEPT table. For each source record that is to be loaded into the DEPT table:

- The characters in positions 7 through 9 are loaded into the DEPTNO column.
- The characters in positions 10 through 35 are loaded into the DEPTNAME column.
- The characters in positions 36 through 41 are loaded into the MGRNO column.
- The characters in positions 42 through 44 are loaded into the ADMRDEPT column.

```
LOAD DATA INDDN EMPLDS
 RESUME YES
 INTO TABLE DSN8B10.EMP
 NUMRECS   100000
 WHEN (1:3)='LKA'
 INTO TABLE SMITH.EMPEMPL
 NUMRECS   100
 WHEN (1:3)='ABC'
 INTO TABLE DSN8B10.DEPT
 NUMRECS   500
 WHEN (1:3)='LKA'
 (DEPTNO POSITION (7:9) CHAR,
   DEPTNAME POSITION (10:35) CHAR,
   MGRNO POSITION (36:41) CHAR,
   ADMRDEPT POSITION (42:44) CHAR)
```

Figure 29. Example LOAD statement that loads selected records into multiple tables

Example 4: Loading data of different data types

The control statement specifies that LOAD is to load data from the SYSRECPJ input data set into table DSN8B10.PROJ. The input data set is identified by the INDDN option. Assume that the table space that contains table DSN8B10.PROJ is currently empty.

For each input record, data is loaded into the specified columns (that is, PROJNO, PROJNAME, DEPTNO, and so on) to form a table row. Any other PROJ columns that are not specified in the LOAD control statement are set to the default value.

The POSITION clauses define the starting positions of the fields in the input data set. The ending positions of the fields in the input data set are implicitly defined either by the length specification of the data type (CHAR *length*) or the length specification of the external numeric data type (LENGTH).

The numeric data that is represented in SQL constant format (EXTERNAL format) is converted to the correct internal format by the LOAD process and placed in the indicated column names. The two dates (PRSTDATE and PRENDATE) are

assumed to be represented by eight digits and two separator characters, as in the USA format (for example, 11/15/2006). The length of the date fields is given as 10 explicitly, although in many cases, the default is the same value.

```
LOAD DATA INDDN(SYSRECPJ)
 INTO TABLE DSN8B10.PROJ
  (PROJNO   POSITION  (1) CHAR(6),
   PROJNAME POSITION  (8) CHAR(22),
   DEPTNO   POSITION (31) CHAR(3),
   RESPEMP  POSITION (35) CHAR(6),
   PRSTAFF  POSITION (42) DECIMAL EXTERNAL(5),
   PRSTDATE POSITION (48) DATE EXTERNAL(10),
   PRENDATE POSITION (59) DATE EXTERNAL(10),
   MAJPROJ  POSITION (70) CHAR(6))
```

Figure 30. Example of loading data of different data types

Example 5: Loading data in delimited file format

The control statement specifies that data in delimited format is to be loaded into the specified columns (FILENO, DATE1, TIME1, and TIMESTMP) in table TBQB0103. The FORMAT DELIMITED option indicates that the data is in delimited format. The data is to be loaded from the SYSREC data set, which is the default.

The COLDEL option indicates that the column delimiter is a comma (,). The CHARDEL option indicates that the character string delimiter is a double quotation mark ("). The DECPT option indicates that the decimal point character is a period (.). You are not required to explicitly specify these particular characters, because they are all defaults.

```
//*
//STEP3    EXEC DSNUPROC,UID='JUQBU101.LOAD2',TIME=1440,
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSERR   DD DSN=JUQBU101.LOAD2.STEP3.SYSERR,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4096,(20,20),,,ROUND)
//SYSDISC  DD DSN=JUQBU101.LOAD2.STEP3.SYSDISC,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4096,(20,20),,,ROUND)
//SYSMAP   DD DSN=JUQBU101.LOAD2.STEP3.SYSMAP,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4096,(20,20),,,ROUND)
//SYSUT1   DD DSN=JUQBU101.LOAD2.STEP3.SYSUT1,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4096,(20,20),,,ROUND)
//UTPRINT  DD SYSOUT=*
//SORTOUT  DD DSN=JUQBU101.LOAD2.STEP3.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4096,(20,20),,,ROUND)
//SYSIN    DD *
   LOAD DATA
        FORMAT DELIMITED COLDEL ',' CHARDEL '"' DECPT '.'
        INTO TABLE TBQB0103
            (FILENO   CHAR,
             DATE1    DATE EXTERNAL,
             TIME1    TIME EXTERNAL,
             TIMESTMP TIMESTAMP EXTERNAL)
 /*
//SYSREC   DD *
 "001", 2000-02-16, 00.00.00, 2000-02-16-00.00.00.0000
 "002", 2001-04-17, 06.30.00, 2001-04-17-06.30.00.2000
```

```
"003", 2002-06-18, 12.30.59, 2002-06-18-12.30.59.4000
"004", 1991-08-19, 18.59.30, 1991-08-19-18.59.30.8000
"005", 2000-12-20, 24.00.00, 2000-12-20-24.00.00.0000
/*
```

Figure 31. Example of loading data in delimited file format

Example 6: Concatenating multiple input records

The control statement specifies that data from the SYSRECOV input data set is to be loaded into table DSN8B10.TOPTVAL. The input data set is identified by the INDDN option. The table space that contains the TOPTVAL table is currently empty.

Some of the data that is to be loaded into a single row spans more than one input record. In this situation, an X in column 72 indicates that the input record contains fields that are to be loaded into the same row as the fields in the next input record. In the LOAD control statement, `CONTINUEIF(72:72)='X'` indicates that LOAD is to concatenate any input records that have an X in column 72 with the next record before loading the data.

For each assembled input record (that is, after the concatenation), fields are loaded into the DSN8B10.TOPTVAL table columns (that is, MAJSYS, ACTION, OBJECT ..., DSPINDEX) to form a table row. Any columns that are not specified in the LOAD control statement are set to the default value.

The POSITION clauses define the starting positions of the fields in the assembled input records. Starting positions are numbered from the first column of the internally assembled input record, not from the start of the input records in the sequential data set. The ending positions of the fields are implicitly defined by the length specification of the data type (CHAR *length*).

No conversions are required to load the input character strings into their designated columns, which are also defined to be fixed-length character strings. However, because columns INFOTXT, HELPTXT, and PFKTXT are defined as 79 characters in length and the strings that are being loaded are 71 characters in length, those strings are padded with blanks as they are loaded.

```
LOAD DATA INDDN(SYSRECOV) CONTINUEIF(72:72)='X'
  INTO TABLE DSN8B10.TOPTVAL
  (MAJSYS   POSITION   (2) CHAR(1),
   ACTION   POSITION   (4) CHAR(1),
   OBJECT   POSITION   (6) CHAR(2),
   SRCHCRIT POSITION   (9) CHAR(2),
   SCRTYPE  POSITION  (12) CHAR(1),
   HEADTXT  POSITION  (80) CHAR(50),
   SELTXT   POSITION (159) CHAR(50),
   INFOTXT  POSITION (238) CHAR(71),
   HELPTXT  POSITION (317) CHAR(71),
   PFKTXT   POSITION (396) CHAR(71),
   DSPINDEX POSITION (475) CHAR(2))
```

Figure 32. Example of concatenating multiple input records before loading the data

Example 7: Loading null values

The control statement specifies that data from the SYSRECST data set is to be loaded into the specified columns in table SYSIBM.SYSSTRINGS. The input data

set is identified by the INDDN option. The NULLIF option for the ERRORBYTE and SUBBYTE columns specifies that if the input field contains a blank, LOAD is to place a null value in the indicated column for that particular row. The DEFAULTIF option for the TRANSTAB column indicates that the utility is to load the default value for this column if the input field value is GG. The CONTINUEIF option indicates that LOAD is to concatenate any input records that have an X in column 80 with the next record before loading the data.

```
LOAD DATA INDDN(SYSRECST) CONTINUEIF(80:80)='X' RESUME(YES)
     INTO TABLE SYSIBM.SYSSTRINGS
           (INCCSID   POSITION(  1) INTEGER EXTERNAL(5),
            OUTCCSID  POSITION(  7) INTEGER EXTERNAL(5),
            TRANSTYPE POSITION( 13) CHAR(2),
            ERRORBYTE POSITION( 16) CHAR(1) NULLIF(ERRORBYTE=' '),
            SUBBYTE   POSITION( 18) CHAR(1) NULLIF(SUBBYTE=' '),
            TRANSPROC POSITION( 20) CHAR(8),
            IBMREQD   POSITION( 29) CHAR(1),
            TRANSTAB  POSITION( 31) CHAR(256) DEFAULTIF(TRANSTYPE='GG'))
```

Figure 33. Example of loading null values

Example 8: Enforcing referential constraints when loading data

The control statement specifies that data from the SYSREC input data set is to be loaded into table DSN8B10.PROJ. The default input data set is SYSREC. The table space that contains the PROJ table is not empty. RESUME YES indicates that the records are to be added to the end of the table.

The ENFORCE CONSTRAINTS option indicates that LOAD is to enforce referential constraints on the data that is being added. This option is also the default. All violations are reported in the output. All records causing these violations are not loaded and placed in the SYSDISC data set, which is the default data set for discarded records.

The CONTINUEIF option indicates that before loading the data LOAD is to concatenate any input records that have an X in column 72 with the next record.

```
LOAD DATA INDDN(SYSREC) CONTINUEIF(72:72)='X'
 RESUME YES
 ENFORCE CONSTRAINTS
 INTO TABLE DSN8B10.PROJ
  (PROJNO POSITION (1) CHAR (6),
   PROJNAME POSITION (8) VARCHAR,
   DEPTNO POSITION (33) CHAR (3),
   RESPEMP POSITION (37) CHAR (6),
   PRSTAFF POSITION (44) DECIMAL EXTERNAL (5),
   PRSTDATE POSITION (50) DATE EXTERNAL,
   PRENDATE POSITION (61) DATE EXTERNAL,
   MAJPROJ POSITION (80) CHAR (6) NULLIF(MAJPROJ='      '))
```

Figure 34. Example of enforcing referential constraints when loading data

Example 9: Loading data without enforcing referential constraints

The control statement specifies that data from the SYSRECAC input data set is to be loaded into table DSN8810.ACT. The INDDN option identifies the input data set.

ENFORCE NO indicates that the LOAD utility is not to enforce referential constraints and places the table in CHECK-pending status. Use this option if you

are loading data into several tables that are related in such a way that the referential constraints cannot be checked until all tables are loaded. For example, a column in table A depends on a column in table B; a column in table B depends on a column in table C; and a column in table C depends on a column in table A.

The POSITION clauses define the starting positions of the fields in the input data set. The ending positions of the fields in the input data set are implicitly defined by the length specification of the data type (CHAR *length*). In this case, the characters in positions 1 through 3 are loaded into the ACTNO column, the characters in positions 5 through 10 are loaded into the ACTKWD column, and the characters in position 13 onward are loaded into the ACTDESC column. Because the ACTDESC column is of type VARCHAR, the input data needs to contain a 2-byte binary field that contains the length of the character field. This binary field begins at position 13.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UB.LOAD',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSRECAC   DD DSN=IUIQU2UB.LOAD.DATA,DISP=SHR,VOL=SER=SCR03,
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD DSN=IUIQU2UB.LOAD.STEP1.SYSUT1,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=IUIQU2UB.LOAD.STEP1.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
LOAD DATA INDDN(SYSRECAC) RESUME YES
     INTO TABLE DSN8B10.ACT
          (ACTNO    POSITION(1) INTEGER EXTERNAL(3),
           ACTKWD   POSITION(5) CHAR(6),
           ACTDESC POSITION(13) VARCHAR)
     ENFORCE NO
//*
```

Figure 35. Example of loading data without enforcing referential constraints

Example 10: Loading data by using a parallel index build

The control statement specifies that data from the SYSREC input data set is to be loaded into table DSN8810.DEPT. Assume that 22 000 rows need to be loaded into table DSN8B10.DEPT, which has three indexes. In this example, the SORTKEYS option is used to improve performance by forcing a parallel index build. The SORTKEYS option specifies 66 000 as an estimate of the number keys to sort in parallel during the SORTBLD phase. (This estimate was computed by using the calculation that is described in "Improving LOAD performance" on page 334.) Because more than one index needs to be built, LOAD builds the indexes in parallel.

The SORTDEVT and SORTNUM keywords specify that the sort program is to dynamically allocate the required data sets. If sufficient virtual storage resources are available, one utility subtask pair is started to build each index. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing, which includes a DD statement that allocates UTPRINT to SYSOUT.

The CONTINUEIF option indicates that, before loading the data, LOAD is to concatenate any input records that have a plus sign (+) in column 79 and a plus sign (+) in column 80 with the next record.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.LOAD',UTPROC='',SYSTEM='DSN'
//SORTOUT  DD DSN=SAMPJOB.LOAD.STEP1.SORTOUT,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SYSUT1   DD DSN=SAMPJOB.LOAD.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SYSERR   DD DSN=SAMPJOB.LOAD.STEP1.SYSERR,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(2000,(20,20),,,ROUND)
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=2400)
//SYSMAP   DD DSN=SAMPJOB.LOAD.STEP1.SYSMAP,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(2000,(20,20),,,ROUND),
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=2400)
//SYSREC   DSN=SAMPJOB.TEMP.DATA,DISP=SHR,UNIT=SYSDA
//SYSIN    DD *
LOAD DATA REPLACE INDDN SYSREC CONTINUEIF(79:80)='++'
 SORTKEYS 66000 SORTDEVT SYSDA SORTNUM 3
 INTO TABLE DSN8B10.DEPT
/*
```

Figure 36. Example of loading data by using a parallel index build

Example 11: Creating inline copies

The control statement specifies that the LOAD utility is to load data from the SYSREC data set into the specified columns of table ADMF001.TB0S3902.

COPYDDN(COPYT1) indicates that LOAD is to create inline copies and write the primary image copy to the data set that is defined by the COPYT1 template. This template is defined in one of the preceding TEMPLATE control statements. To create an inline copy, you must also specify the REPLACE option, which indicates that any data in the table space is to be replaced.

`CONTINUEIF(79:80)='++'` indicates that, before loading the data, LOAD is to concatenate any input records that have a plus sign (+) in column 79 and a plus sign (+) in column 80 with the next record.

The ERRDDN(ERRDDN) and MAPDDN(MAP) options indicate that information about errors is to be written to the data sets that are defined by the ERRDDN and MAP templates. DISCARDDN(DISCARD) specifies that discarded records (those that violate referential constraints) are to be written to the data set that is defined by the DISCARD template. WORKDDN(UT1,OUT) specifies the temporary work files for sort input and output; LOAD is to use the data set that is defined by the UT1 template for sort input and the data set that is defined by the OUT template for sort output.

```
//STEP1    EXEC DSNUPROC,UID='JUOSU339.LOAD1',TIME=1440,
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSREC   DD DSN=CUST.FM.CINT135.DATA,DISP=SHR,VOL=SER=FORDMD,
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
  TEMPLATE ERRDDN  UNIT(SYSDA)
                   DSN(JUOSU339.T&TI..&ST..ERRDDN)
                   SPACE(50,10) TRK
  TEMPLATE UT1     UNIT(SYSDA)
                   DSN(JUOSU339.T&TI..&ST..SYSUT1)
                   SPACE(50,10) TRK
  TEMPLATE OUT     UNIT(SYSDA)
                   DSN(JUOSU339.T&TI..&ST..SYSOUT)
                   SPACE(50,10) TRK
  TEMPLATE MAP     UNIT(SYSDA)
                   DSN(JUOSU339.T&TI..&ST..SYSMAP)
                   SPACE(50,10) TRK
```

```
  TEMPLATE DISCARD UNIT(SYSDA)
                   DSN(JUOSU339.T&TI..&ST..DISCARD)
                   SPACE(50,10) TRK
  TEMPLATE COPYT1
           UNIT(SYSDA)
           DSN(JUOSU339.COPY1.STEP1.&SN..COPY&LR.&PB.)
           DISP(MOD,CATLG,CATLG)
           SPACE(60,30) TRK
  LOAD DATA INDDN SYSREC REPLACE
   CONTINUEIF(79:80)='++'
   COPYDDN(COPYT1)
   ERRDDN(ERRDDN)
   WORKDDN(UT1,OUT)
   MAPDDN(MAP)
   DISCARDDN(DISCARD)
  INTO TABLE
       ADMF001.TBOS3902
  ( ID_PARTITION       POSITION(1)   CHAR(1),
    CD_PLANT           POSITION(2)   CHAR(5),
    NO_PART_BASE       POSITION(7)   CHAR(9),
    NO_PART_PREFIX     POSITION(16)  CHAR(7),
   NO_PART_SUFFIX     POSITION(23)  CHAR(8),
  NO_PART_CONTROL    POSITION(31)   CHAR(3),
  DT_TRANS_EFFECTIVE POSITION(34)   DATE EXTERNAL(10),
  CD_INV_TRANSACTION POSITION(44)   CHAR(3),
  TS_PROCESS         POSITION(47)   TIMESTAMP EXTERNAL(26),
  QT_INV_TRANSACTION POSITION(73)   INTEGER,
  CD_UNIT_MEAS_USAGE POSITION(77)   CHAR(2),
  CD_USER_ID         POSITION(79)   CHAR(7),
  NO_DEPT            POSITION(86)   CHAR(4),
  NO_WORK_CENTER     POSITION(90)   CHAR(6))
/*
```

Figure 37. Example of creating inline copies

Example 12: Collecting statistics

This example is similar to the previous example, except that the STATISTICS option and other related options have been added so that during the LOAD job, DB2 also gathers statistics for the table space. Gathering these statistics eliminates the need to run the RUNSTATS utility after completing the LOAD operation.

The TABLE, COLUMN, and INDEX options specify that information is to be gathered for columns QT_INV_TRANSACTION, NO_DEPT, NO_PART_PREFIX, DT_TRANS_EFFECTIVE and index ID0S3902 for table TB0S3902. SAMPLE 53 indicates that LOAD is to sample 53% of the rows when gathering statistics on non-leading-indexed columns of an index or non-indexed columns. For the index, statistics on all of the distinct values in all of the key column combinations are collected by default. FREQVAL NUMCOLS 4 COUNT 20 indicates that 20 frequent values are to be collected on the concatenation of the first four key columns.

REPORT YES indicates that the statistics are to be sent to SYSPRINT as output. UPDATE ALL and HISTORY ALL indicate that all collected statistics are to be updated in the catalog and catalog history tables.

```
//STEP1    EXEC DSNUPROC,UID='JUOSU339.LOAD1',TIME=1440,
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSREC   DD DSN=CUST.FM.CINT135.DATA,DISP=SHR,VOL=SER=FORDMD,
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
  TEMPLATE ERRDDN  UNIT(SYSDA)
```

```
                  DSN(JUOSU339.T&TI..&ST..ERRDDN)
                  SPACE(50,10) TRK
  TEMPLATE UT1    UNIT(SYSDA)
                  DSN(JUOSU339.T&TI..&ST..SYSUT1)
                  SPACE(50,10) TRK
  TEMPLATE OUT    UNIT(SYSDA)
                  DSN(JUOSU339.T&TI..&ST..SYSOUT)
                  SPACE(50,10) TRK
  TEMPLATE MAP    UNIT(SYSDA)
                  DSN(JUOSU339.T&TI..&ST..SYSMAP)
                  SPACE(50,10) TRK
  TEMPLATE DISCARD UNIT(SYSDA)
                  DSN(JUOSU339.T&TI..&ST..DISCARD)
                  SPACE(50,10) TRK
  TEMPLATE COPYT1
           UNIT(SYSDA)
           DSN(JUOSU339.COPY1.STEP1.&SN..COPY&LR.&PB.)
           DISP(MOD,CATLG,CATLG)
           SPACE(60,30) TRK
  LOAD DATA INDDN SYSREC REPLACE
   CONTINUEIF(79:80)='++'
   COPYDDN(COPYT1)
   STATISTICS
     TABLE (TBOS3902) SAMPLE 53
       COLUMN (QT_INV_TRANSACTION,
               NO_DEPT,
               NO_PART_PREFIX,
               DT_TRANS_EFFECTIVE)
     INDEX (IDOS3902
       FREQVAL NUMCOLS 4 COUNT 20)
     REPORT YES UPDATE ALL HISTORY ALL
   ERRDDN(ERRDDN)
   WORKDDN(UT1,OUT)
   MAPDDN(MAP)
   DISCARDDN(DISCARD)
  INTO TABLE
       ADMF001.TBOS3902
  ( ID_PARTITION       POSITION(1)   CHAR(1),
    CD_PLANT           POSITION(2)   CHAR(5),
    NO_PART_BASE       POSITION(7)   CHAR(9),
    NO_PART_PREFIX     POSITION(16)  CHAR(7),
   NO_PART_SUFFIX     POSITION(23)  CHAR(8),
  NO_PART_CONTROL    POSITION(31)   CHAR(3),
  DT_TRANS_EFFECTIVE POSITION(34)   DATE EXTERNAL(10),
  CD_INV_TRANSACTION POSITION(44)   CHAR(3),
  TS_PROCESS         POSITION(47)   TIMESTAMP EXTERNAL(26),
  QT_INV_TRANSACTION POSITION(73)   INTEGER,
  CD_UNIT_MEAS_USAGE POSITION(77)   CHAR(2),
  CD_USER_ID         POSITION(79)   CHAR(7),
  NO_DEPT            POSITION(86)   CHAR(4),
  NO_WORK_CENTER     POSITION(90)   CHAR(6))
/*
```

Figure 38. Example of collecting statistics

Example 13: Loading Unicode data

The following control statement specifies that Unicode data from the REC1 input data set is to be loaded into table ADMF001.TBMG0301. The UNICODE option specifies the type of input data. Only data that satisfies the condition that is specified in the WHEN clause is to be loaded. The CCSID option specifies the

three coded character set identifiers for the input file: one for SBCS data, one for mixed data, and one for DBCS data. LOG YES indicates that logging is to occur during the LOAD job.

```
LOAD DATA INDDN REC1     LOG YES REPLACE
   UNICODE CCSID(00367,01208,01200)
   INTO TABLE "ADMF001 "."TBMG0301"
   WHEN(00004:00005 = X'0003')
```

Example 14: Loading data from multiple input data sets by using partition parallelism

The LOAD control statement in this example contains a series of INTO TABLE statements that specify which data is to be loaded into which partitions of table DBA01.TBLX3303. For each INTO TABLE statement:

- Data is to be loaded into the partition that is identified by the PART option. For example, the first INTO TABLE statement specifies that data is to be loaded into the first partition of table DBA01.TBLX3303.
- Data is to be loaded from the data set that is identified by the INDDN option. For example, the data from the PART1 data set is to be loaded into the first partition.
- Any discarded rows are to be written to the data set that is specified by the DISCARDDN option. For example, rows that are discarded during the loading of data from the PART1 data set are written to the DISC1 data set.
- The data is loaded into the specified columns (EMPNO, LASTNAME, and SALARY).

LOAD uses partition parallelism to load the data into these partitions.

The TEMPLATE utility control statement defines the data set naming convention for the data set that is to be dynamically allocated during the following LOAD job. The name of the template is ERR3. The ERRDDN option in the LOAD statement specifies that any errors are to be written to the data set that is defined by this ERR3 template.

```
 TEMPLATE ERR3
         DSN &UT..&JO..&ST..ERR3&MO.&DAY.
         UNIT SYSDA  DISP(NEW,CATLG,CATLG)
  LOAD DATA
    REPLACE
    ERRDDN ERR3
    INTO TABLE DBA01.TBLX3303
      PART 1
      INDDN PART1
      DISCARDDN DISC1
        (EMPNO      POSITION(1)    CHAR(6),
         LASTNAME   POSITION(8)    VARCHAR(15),
         SALARY     POSITION(25)   DECIMAL(9,2))
    .
    .
    .
    INTO TABLE DBA01.TBLX3303
      PART 5
      INDDN PART5
      DISCARDDN DISC5
        (EMPNO      POSITION(1)    CHAR(6),
         LASTNAME   POSITION(8)    VARCHAR(15),
         SALARY     POSITION(25)   DECIMAL(9,2))
/*
```

Figure 39. Example of loading data from individual data sets

Example 15: Loading data from another table in the same system by using a declared cursor

The following LOAD control statement specifies that all rows that are identified by cursor C1 are to be loaded into table MYEMP. The INCURSOR option is used to specify cursor C1, which is defined in the EXEC SQL utility control statement. Cursor C1 points to the rows that are returned by executing the statement SELECT * FROM DSN8810.EMP. In this example, the column names in table DSN8810.EMP are the same as the column names in table MYEMP. Note that the cursor cannot be defined on the same table into which DB2 is to load the data.

```
EXEC SQL
  DECLARE C1 CURSOR FOR SELECT * FROM DSN8810.EMP
ENDEXEC
LOAD DATA
INCURSOR(C1)
REPLACE
INTO TABLE MYEMP
STATISTICS
```

Example 16: Loading data partitions in parallel from a remote site by using a declared cursor

The LOAD control statement in this example specifies that for each specified partition of table MYEMPP, the rows that are identified by the specified cursor are to be loaded. In each INTO TABLE statement, the PART option specifies the partition number, and the INCURSOR option specifies the cursor. For example, the rows that are identified by cursor C1 are to be loaded into the first partition. The data for each partition is loaded in parallel.

Each cursor is defined in a separate EXEC SQL utility control statement and points to the rows that are returned by executing the specified SELECT statement. These SELECT statement are being executed on a table at a remote server, so the

three-part name is used to identify the table. In this example, the column names in table CHICAGO.DSN8810.EMP are the same as the column names in table MYEMPP.

The four partitions being loaded each contain a different number of records. To improve the sizing of the sort work data sets that the LOAD utility requires, the number of records being loaded into each partition is specified on the NUMRECS keyword for each table.

```
EXEC SQL
  DECLARE C1 CURSOR FOR SELECT * FROM CHICAGO.DSN8810.EMP
  WHERE EMPNO <= '099999'
ENDEXEC
EXEC SQL
  DECLARE C2 CURSOR FOR SELECT * FROM CHICAGO.DSN8810.EMP
  WHERE EMPNO > '099999' AND EMPNO <= '199999'
ENDEXEC
EXEC SQL
  DECLARE C3 CURSOR FOR SELECT * FROM CHICAGO.DSN8810.EMP
  WHERE EMPNO > '199999' AND EMPNO <= '299999'
ENDEXEC
EXEC SQL
  DECLARE C4 CURSOR FOR SELECT * FROM CHICAGO.DSN8810.EMP
  WHERE EMPNO > '299999' AND EMPNO <= '999999'
ENDEXEC
LOAD DATA
  INTO TABLE MYEMPP PART 1 REPLACE INCURSOR(C1) NUMRECS 10000
  INTO TABLE MYEMPP PART 2 REPLACE INCURSOR(C2) NUMRECS 50000
  INTO TABLE MYEMPP PART 3 REPLACE INCURSOR(C3) NUMRECS 100000
  INTO TABLE MYEMPP PART 4 REPLACE INCURSOR(C4) NUMRECS 50000
```

Figure 40. Example of loading data partitions in parallel using a declared cursor

Example 17: Loading LOB data from a file

The LOAD control statement in this example specifies that data from 000130DSN!10.SDSNIVPD(DSN8R130) is to be loaded into the MY_EMP_PHOTO_RESUME table. The characters in positions 1 through 6 are loaded into the EMPNO column, and the characters starting from position 7 are to be loaded into the RESUME column. CLOBF indicates that the characters in position 7 are the name of a file from which a CLOB is to be loaded.

REPLACE indicates that the new data will replace any existing data. Although no logging is to be done, as indicated by the LOG NO option, the table space is not to be set in CHECK-pending state, because NOCOPYPEND is specified.

SORTKEYS 1 indicates that one index key is to be sorted.

```
//*****************************************************************
//*   LOAD LOB from file
//*****************************************************************
//LOADIT   EXEC DSNUPROC,UID='LOADIT',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSREC   DD*
000130DSN!10.SDSNIVPD(DSN8R130)
//SYSUT1   DD DSN=SYSADM.LOAD.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=SYSADM.LOAD.SORTOUT,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD  *
 LOAD DATA
   REPLACE LOG NO NOCOPYPEND
   SORTKEYS 1
      INTO TABLE MY_EMP_PHOTO_RESUME
      (EMPNO    POSITION(1:6) CHAR(6),
       RESUME   POSITION(7:31)   CHAR CLOBF)
```

Figure 41. Example of loading LOB data from a file

Example 18: Loading with parallel subtasks

The following LOAD statement specifies that LOAD is to use multiple parallel subtasks, as indicated by the PARALLEL keyword. Because no value is specified with the PARALLEL keyword, DB2 determines the optimal degree of parallelism. This use of parallelism can potentially reduce the elapsed time that is required for loading large amounts of data.

```
LOAD DATA
PARALLEL
RESUME YES
SHRLEVEL NONE
INDDN INPUT1
EBCDIC
CONTINUEIF(80:80)='-'
INTO TABLE SCTX1300.TB_HISTORY_PART
(HISTORY_DAILY POSITION(1:11) INT EXTERNAL,
 HISTORY_ROWNUM POSITION(13:23) INT EXTERNAL,
 HISTORY_CUSTOMER_ID POSITION(25:35) INT EXTERNAL,
 HISTORY_CUSTOMER_ACCOUNT_ID POSITION(37:50) DECIMAL EXTERNAL,
 HISTORY_CUSTOMER_DISTRICT_ID POSITION(52:53) CHAR,
 HISTORY_CUSTOMER_WAREHOUSE_ID POSITION(55:64) CHAR,
 HISTORY_DISTRICT_ID POSITION(66:67) CHAR,
 HISTORY_TRANSACTION_ID POSITION(69:70) CHAR,
 HISTORY_WAREHOUSE_ID POSITION(72:81) CHAR,
 HISTORY_DATE POSITION(83:108) TIMESTAMP EXTERNAL,
 HISTORY_AMOUNT POSITION(110:126) DECIMAL EXTERNAL,
 HISTORY_STATUS POSITION(128:144) VARCHAR,
 HISTORY_DATA POSITION(3874:3899) VARCHAR)
```

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Chapter 21. MERGECOPY

The MERGECOPY online utility merges copies or inline copies that other utilities produce. The COPY and COPYTOCOPY utilities produce image copies, and the LOAD and REORG utilities produce inline copies.

The utility can merge several incremental copies of a table space to make one incremental copy. It can also merge incremental copies with a full image copy to make a new full image copy. You cannot run MERGECOPY on concurrent copies or FlashCopy image copies.

MERGECOPY operates on the image copy data sets of a table space, and not on the table space itself.

If you are creating copies in a JES3 environment, ensure that sufficient units are available to mount the required image copies. In a JES3 environment, if the number of image copies that are to be restored exceeds the number of available online and offline units, and if the MERGECOPY job successfully allocates all available units, the job waits for more units to become available.

Output

Output from the MERGECOPY utility consists of one of the following types of copies:

- A new single incremental image copy
- A new full image copy

You can create the new image copy for the local or recovery site.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- IMAGCOPY privilege for the database

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- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- DATAACCESS authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute MERGECOPY, but only on a table space in the DSNDB01 or DSNDB06 database.

Restrictions on running MERGECOPY

- MERGECOPY cannot merge image copies into a single incremental image copy for the other site, that is:
  - At local sites, you cannot use RECOVERYDDN with NEWCOPY NO.
  - At recovery sites, you cannot use COPYDDN with NEWCOPY NO.
- When none of the keywords NEWCOPY, COPYDDN, or RECOVERYDDN is specified, the default, NEWCOPY NO COPYDDN(SYSCOPY), is valid for the local site only.
- You cannot run MERGECOPY on concurrent copies.
- You cannot run the MERGECOPY utility on the DSNDB01.DBD01, DSNDB01.SYSUTILX, DSNDB06.SYSTSCPY, or DSNDB01.SYSDBDXA table spaces, because you cannot make incremental copies of those table spaces.
- MERGECOPY cannot be run on a table space during the period after RECOVER is run to a point in time before materialization of pending definition changes and before REORG is run to complete the point-in-time recovery process.

Execution phases of MERGECOPY

The MERGECOPY utility operates in these phases:

Phase Description

UTILINIT
Performs initialization

MERGECOP
Merges incremental copies

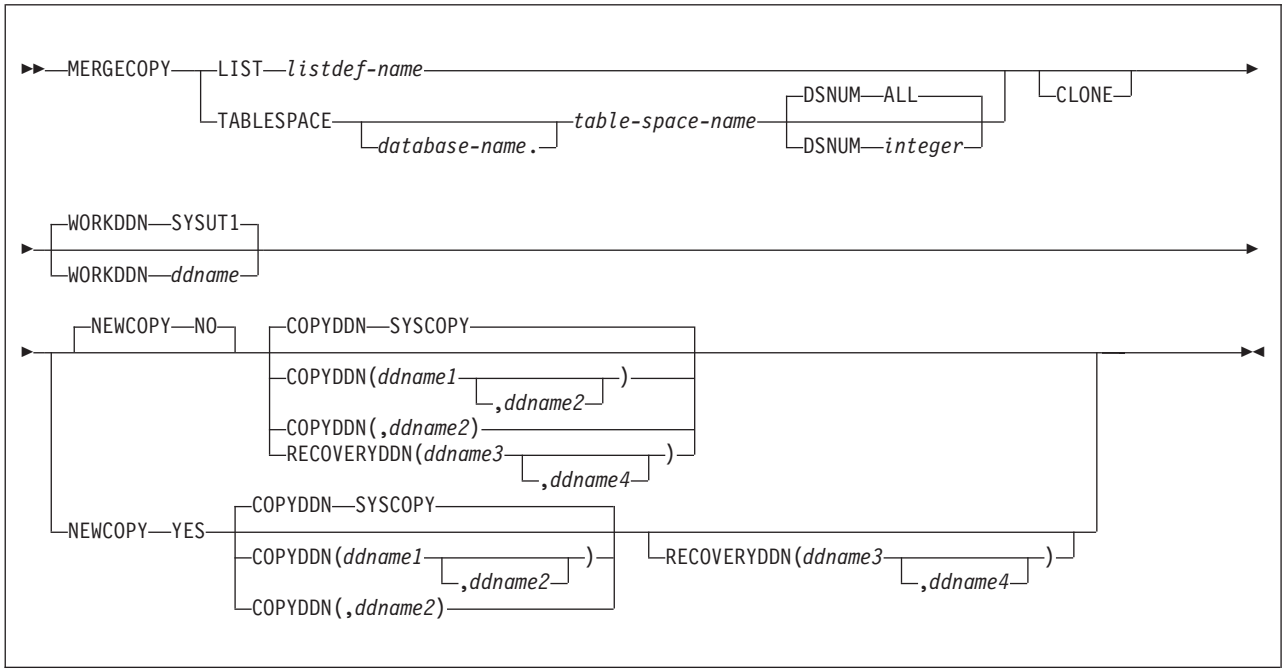
UTILTERM
Performs cleanup

Syntax and options of the MERGECOPY control statement

The MERGECOPY utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, you can use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

LIST *listdef-name*

Specifies the name of a previously defined LISTDEF list name that contains only table spaces. You can specify one LIST keyword per MERGECOPY control statement. Do not specify LIST with the TABLESPACE keyword. MERGECOPY is invoked once for each table space in the list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*

Specifies the table space that is to be copied, and, optionally, the database to which it belongs.

database-name

The name of the database that the table space belongs to. The default value is **DSNDB04**.

table-space-name

The name of the table space whose incremental image copies are to be merged.

You cannot run the MERGECOPY utility on the DSNDB01.DBD01, DSNDB01.SYSUTILX, DSNDB06.SYSTSCPY, or DSNDB01.SYSDBDXA table spaces, because you cannot make incremental copies of those table spaces. Because MERGECOPY does not directly access the table space whose copies it is merging, it does not interfere with concurrent access to that table space.

DSNUM

Identifies the table space or a partition or data set within the table space that is to be merged. DSNUM is optional.

ALL
Merges the entire table space.

integer
Is the number of a partition or data set that is to be merged. The maximum is 4096.

For a partitioned table space, the integer is its physical partition number.

For a nonpartitioned table space, find the integer at the end of the data set name as cataloged in the VSAM catalog. The data set name has the following format, where *y* is either I or J, *z* is either 1 or 2, and *nnn* is the data set integer:

catname.DSNDB*x*.*dbname*.*tsname*.*y*000*z*.A*nnn*

You cannot specify DSNUM and LIST in the same MERGECOPY control statement. Use PARTLEVEL on the LISTDEF instead. If image copies were taken by data set (rather than by table space), MERGECOPY must use the copies by data set.

CLONE
Indicates that MERGECOPY is to process only image copy data sets that were taken against clone objects. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

WORKDDN *ddname*
Specifies a DD statement for a temporary data set or template, which is to be used for intermediate merged output. WORKDDN is optional.

ddname is the DD name. The **default** value is **SYSUT1**.

Use the WORKDDN option if you are not able to allocate enough data sets to execute MERGECOPY; in that case, a temporary data set is used to hold intermediate output. If you omit the WORKDDN option, you might find that only some of the image copy data sets are merged. When MERGECOPY has ended, a message is issued that tells the number of data sets that exist and the number of data sets that have been merged. To continue the merge, repeat MERGECOPY with a new output data set.

NEWCOPY
Specifies whether incremental image copies are to be merged with the full image copy. NEWCOPY is optional.

NO Merges incremental image copies into a single incremental image copy but does not merge them with the full image copy.

YES
Merges all incremental image copies with the full image copy to form a new full image copy.

COPYDDN (*ddname1*,*ddname2***)**
Specifies the DD statements for the output image copy data sets at the local site. *ddname1* is the primary output image copy data set. *ddname2* is the backup output image copy data set. COPYDDN is optional.

The **default** value is **COPYDDN**(**SYSCOPY**), where SYSCOPY identifies the primary data set.

The COPYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility

processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

RECOVERYDDN (*ddname3***,***ddname4***)**
Specifies the DD statements for the output image copy data sets at the recovery site. You can have a maximum of two output data sets; the outputs are identical. *ddname3* is the primary output image copy data set. *ddname4* is the backup output image copy data set. RECOVERYDDN is optional. No default value exists for RECOVERYDDN.

The RECOVERYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

Related reference:

Chapter 35, "TEMPLATE," on page 789

Chapter 19, "LISTDEF," on page 221

Data sets that MERGECOPY uses

The MERGECOPY utility uses a number of data sets during its operation.

The following table lists the data sets that MERGECOPY uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 53. Data sets that MERGECOPY uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
Image copy data set	Image copy data set that contains the resulting image copy. Specify its DD name with the COPYDDN option of the utility control statement. The default DD name is SYSCOPY.	Yes
Work data set	A temporary data set that is used for intermediate merged output. Specify its DD name with the WORKDDN option of the utility control statement. The default DD name is SYSUT1.	Yes
Input data sets	Image copy data sets that you can preallocate. You define the DD names.	No

Table space
Object whose copies are to be merged.

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Data sets

The input data sets for the merge operation are dynamically allocated. To merge incremental copies, allocate in the JCL a work data set (WORKDDN) and up to

two new copy data sets (COPYDDN) for the utility job. You can allocate the data sets to tape or disk. If you allocate them to tape, you need an additional tape drive for each data set.

With the COPYDDN option of MERGECOPY, you can specify the DD names for the output data sets. The option has the format `COPYDDN (ddname1,ddname2)`, where *ddname1* is the DD name for the primary output data set in the system that currently runs DB2, and *ddname2* is the DD name for the backup output data set in the system that currently runs DB2. The default for *ddname1* is SYSCOPY.

The RECOVERYDDN option of MERGECOPY lets you specify the output image copy data sets at the recovery site. The option has the format `RECOVERYDDN (ddname3, ddname4)`, where *ddname3* is the DD name for the primary output image copy data set at the recovery site, and *ddname4* is the DD name for the backup output data set at the recovery site.

Defining the work data set

The work data set should be at least equal in size to the largest input image copy data set that is being merged. Use the same DCB attributes that are used for the image copy data sets.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for MERGECOPY

The MERGECOPY utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

The following table shows the restrictive state that the utility sets on the target object.

Table 54. Claim classes of MERGECOPY operations.

Target	MERGECOPY
Table space or partition	UTRW

Legend:

UTRW - Utility restrictive state - read-write access allowed.

MERGECOPY can run concurrently on the same target object with any utility **except the following utilities**:

- COPY TABLESPACE
- LOAD
- MERGECOPY
- MODIFY
- RECOVER
- REORG TABLESPACE
- UNLOAD (only when from the same image copy data set)

The target object can be a table space or partition.

Full or incremental image copy

You can use the NEWCOPY parameter if the new copy that MERGECOPY creates is to be an incremental image copy or a full image copy.

In general, creating a new full image copy is recommended. The reasons for this recommendation are as follows:

- A new full image copy creates a new recovery point.
- The additional time that it takes to create a new full image copy does not have any adverse effect on the access to the table space. The only concurrency implication is the access to SYSIBM.SYSCOPY.
- The range of log records that are to be applied by RECOVER is the same for both the new full image copy and the merged incremental image copy.
- Assuming that the copies are on tape, only one tape drive is required for image copies during a RECOVER.

If NEWCOPY is YES, the utility inserts an entry for the new full image copy into the SYSIBM.SYSCOPY catalog table.

If NEWCOPY is NO, the utility:

- Replaces the SYSCOPY records of the incremental image copies that were merged with an entry for the new incremental image copy
- Deletes all SYSCOPY records of the incremental image copies that have been merged.

In either case, if any of the input data sets might not be allocated, or you did not specify a temporary work data set (WORKDDN), the utility performs a partial merge.

For large table spaces, consider using MERGECOPY to create full image copies.

Use MERGECOPY NEWCOPY YES immediately after each incremental image copy. When you use this option, dates become a valid criterion for deletion of image copy data sets and archive logs. A minimum number of tape drives are allocated for MERGECOPY and RECOVER execution.

How MERGECOPY determines which input copy to use

The MERGECOPY utility uses as input the image copies that match the current site.

If MERGECOPY is running at the local site, the local site image copies are chosen as the input to be merged. If MERGECOPY is running at the recovery site, the recovery site image copies are chosen as the input to be merged.

MERGECOPY does not accept a FlashCopy image copy as input.

Merging online copies

If you merge an online copy with incremental copies, the result is a full inline copy. The data set is logically equivalent to a full image copy, but the data within the data set differs in some respects

Related tasks:

"How to use inline COPY with LOAD" on page 332

Using MERGECOPY with individual data sets

Use MERGECOPY on copies of an entire table space, on individual data sets, or on partitions. However, MERGECOPY can only merge incremental copies of the same type. That is, you cannot merge incremental copies of an entire table space with incremental copies of individual data sets to form new incremental copies.

About this task

The attempt to mix the two types of incremental copies results in the following messages:

```
DSNU460I DSNUBCLO - IMAGE COPIES INCONSISTENT.
                    MERGECOPY REQUEST REJECTED
DSNU010I DSNUGBAC - UTILITY EXECUTION COMPLETE,
                    HIGHEST RETURN CODE=4
```

With the NEWCOPY YES option, however, you can merge a full image copy of a table space with incremental copies of the table space and of individual data sets to make a new full image copy of the table space.

If the image copy data sets that you want to merge reside tape, refer to "How the RECOVER utility retains tape mounts" on page 507 for general information about specifying the appropriate parameters on the DD statements.

Using MERGECOPY or COPY

COPY and MERGECOPY can create a full image copy. COPY is required after a LOAD or REORG with LOG NO unless an inline copy is created. However, in other cases an incremental image copy followed by MERGECOPY is a valid alternative.

Avoiding MERGECOPY LOG RBA inconsistencies

MERGECOPY does not use information that was logged between the time of the most recent image copy and the time when MERGECOPY was run. Therefore, you cannot safely delete all log records that were created before you ran MERGECOPY.

About this task

You can safely delete all log records if you run MODIFY RECOVERY and specify the date when MERGECOPY was run as the value of DATE.

Procedure

To delete all log information that is included in a copy that MERGECOPY makes:

1. Find the record of the copy in the catalog table SYSIBM.SYSCOPY by selecting database name, table space name, and date (columns DBNAME, TSNAME, and TIMESTAMP).
2. Column START_RBA contains the RBA of the last image copy that MERGECOPY used. Find the record of the image copy that has the same value of START_RBA.
3. In that record, find the date in column TIMESTAMP. You can use MODIFY RECOVERY to delete all copies and log records for the table space that were made before that date.

Results

RECOVER uses the LOG RBA of image copies to determine the starting point in the log that is needed for recovery. Normally, a timestamp directly corresponds to a LOG RBA. Because of this, and because MODIFY uses dates to clean up recovery history, you might decide to use dates to delete old archive log tapes. This decision might cause a problem if you use MERGECOPY. MERGECOPY inserts the LOG RBA of the last incremental image copy into the SYSCOPY row that is created for the new image copy. The date that is recorded in the TIMESTAMP column of SYSCOPY row is the date that MERGECOPY was executed.

Termination or restart of MERGECOPY

You can terminate and restart the MERGECOPY utility.

You can terminate the a MERGECOPY utility job using the **TERM UTILITY** command.

You can restart MERGECOPY but by default, MERGECOPY restarts at the beginning of the current phase. You can also restart MERGECOPY from the last commit point after receiving an out-of-space condition.

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Sample MERGECOPY control statements

Use the sample control statements as models for developing your own MERGECOPY control statements.

Example 1: Creating a merged incremental copy

The control statement in this example specifies that the MERGECOPY utility is to merge incremental image copies from table space DSN8S11C into a single incremental image copy. The NEWCOPY NO option indicates that these incremental copies are not to be merged with the full image copy. The COPYDDN option specifies that the output image copies are to be written to the data sets that are defined by the COPY1 and COPY2 DD statements.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU107.MERGE1',
//          UTPROC='',SYSTEM='DSN'
//COPY1  DD DSN=IUJMU107.MERGE1.STEP1.COPY1,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//COPY2  DD DSN=IUJMU107.MERGE1.STEP1.COPY2,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD DSN=IUJMU107.MERGE1.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
MERGECOPY TABLESPACE DSN8D11P.DSN8S11C
  COPYDDN      (COPY1,COPY2)
  NEWCOPY  NO
```

Figure 42. Example of creating a merged incremental copy

Example 2: Creating merged incremental copies and using template switching

Each MERGECOPY control statement in this example specifies that MERGECOPY is to merge incremental image copies from the specified table space into a single incremental image copy for that table space. For each control statement, the COPYDDN option specifies that the output image copies are to be written to data sets that are defined by the T1 template. The T1 template has specified the LIMIT option. This means that the output image copies are to be written to DASD, if the output image copy size is less than 5 MB. If the limit is exceeded, template switching from template T1 to template T5 takes place and the output image copies are to be written to TAPE. This template is defined in the TEMPLATE utility control statement.

```
//STEP1    EXEC DSNUPROC,UID='JULTU224.MERGE',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSUT1   DD DSN=JULTU224.MERGE.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
  TEMPLATE T1 UNIT(SYSDA) SPACE CYL
              DSN(T1.&SN..T&TI..COPY&IC.&LOCREM.)
              LIMIT(5 MB,T5)
  TEMPLATE T5 UNIT(3BO)
              DSN(T5.&SN..T&TI..COPY&IC.&LOCREM.)
  MERGECOPY TABLESPACE DBLT2401.TPLT2401 DSNUM ALL NEWCOPY NO
          COPYDDN(T1)
  MERGECOPY TABLESPACE DBLT2401.TLLT24A1 DSNUM ALL NEWCOPY NO
          COPYDDN(T1)
  MERGECOPY TABLESPACE DBLT2401.TLLT24A2 DSNUM ALL NEWCOPY NO
          COPYDDN(T1)
  MERGECOPY TABLESPACE DBLT2401.TLLT24A3 DSNUM ALL NEWCOPY NO
          COPYDDN(T1)
  MERGECOPY TABLESPACE DBLT2401.TLLT24A4 DSNUM ALL NEWCOPY NO
          COPYDDN(T1)
```

Figure 43. Example of using templates

Example 3: Creating a merged full image copy

The control statement in this example specifies that MERGECOPY is to merge all incremental image copies with the full image copy from table space DSN8S11C to create a new full image copy.

```
//STEP1    EXEC DSNUPROC,UID='IUJMU107.MERGE2',
//          UTPROC='',SYSTEM='DSN'
//COPY1  DD DSN=IUJMU107.MERGE2.STEP1.COPY1,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//COPY2  DD DSN=IUJMU107.MERGE2.STEP1.COPY2,DISP=(MOD,CATLG,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD DSN=IUJMU107.MERGE2.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//          UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
MERGECOPY TABLESPACE DSN8D11P.DSN8S11C
  COPYDDN      (COPY1,COPY2)
  NEWCOPY  YES
```

Figure 44. Example of creating a merged full image copy

Example 4: Using MERGECOPY with CLONE keyword

The following control statement specifies that MERGECOPY is to process only image copy data sets that were taken against clone objects.

```
MERGECOPY TABLESPACE DBIQUD01.TPIQUD01 DSNUM ALL CLONE NEWCOPY YES
        COPYDDN(COPYTB1)
```

Related reference:

Chapter 35, “TEMPLATE,” on page 789

Chapter 22. MODIFY RECOVERY

The MODIFY online utility with the RECOVERY option deletes certain records from the DB2 catalog, directory, and DBD. This utility also recycles DB2 version numbers for reuse.

The records that can be deleted include:

- Records from the SYSIBM.SYSCOPY catalog table
- Records from the SYSIBM.SYSOBDS catalog table
- Related log records from the SYSIBM.SYSLGRNX directory table
- Entries from the DBD
- Records that were written before a specific date
- Records of a specific age
- Records for an entire table space, partition, or data set

You can also ensure that a specified number of records is retained.

Run MODIFY regularly to remove outdated information from SYSIBM.SYSCOPY and SYSIBM.SYSLGRNX. These tables, particularly SYSIBM.SYSLGRNX, can become very large and take up a considerable amount of space. By deleting outdated information from these tables, you can help improve performance for processes that access data from these tables.

MODIFY RECOVERY automatically removes the SYSCOPY and SYSLGRNX recovery records that meet the specified criteria for all indexes on the table space with the COPY YES attribute.

Restriction: If a table space is in REORG-pending (REORP) status because a RECOVER job was run to recover the data to a point in time before the materialization of pending definition changes, you cannot run MODIFY RECOVERY on that table space. You must run a REORG TABLESPACE job to complete the point-in-time recovery process before you run MODIFY RECOVERY.

Output

In most cases, MODIFY RECOVERY inserts a SYSIBM.SYSCOPY row with ICTYPE='M' and STYPE='R' to record the RBA or LRSN of the most recently deleted SYSCOPY or SYSLGRNX record. MODIFY RECOVERY does not insert this row when no SYSLGRNX rows are deleted and when the only SYSCOPY rows that it deleted are rows with the following values:

- ICTYPE='F' and STYPE is blank (full image copy)
- ICTYPE='F' and STYPE='C' (concurrent copy of the "I" instance)
- ICTYPE='F' and STYPE='J' (concurrent copy of the "J" instance)
- ICTYPE='I' (incremental image copy)
- ICTYPE='Q' (quiesce point)

For each full and incremental SYSCOPY record that is deleted from SYSIBM.SYSCOPY, the utility returns a message that identifies the name of the copy data set.

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If MODIFY RECOVERY deletes at least one SYSCOPY record, and the target table space or partition is not recoverable from SYSCOPY records or from system-level backups, the target object is placed in COPY-pending status.

For table spaces and indexes that are defined with COPY YES, the MODIFY RECOVERY utility updates the OLDEST_VERSION column of the following catalog tables:
- SYSIBM.SYSTABLESPACE
- SYSIBM.SYSTABLEPART
- SYSIBM.SYSINDEXES
- SYSIBM.SYSINDEXPART

When MODIFY RECOVERY deletes all of the SYSCOPY records for a table space that contain an OLDEST_VERSION value of 0, MODIFY RECOVERY deletes the corresponding rows for that table space from SYSIBM.SYSOBDS. The reason is because point-in-time recovery for the table space is no longer possible.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:
- IMAGCOPY privilege for the database to run MODIFY RECOVERY
- System DBADM authority
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- SYSCTRL or SYSADM authority
- DBADM, authority

An ID with installation SYSOPR authority can also execute MODIFY RECOVERY, but only on a table space in the DSNDB01 or DSNDB06 database.

SYSIBM.SYSCOPY or SYSIBM.SYSLGRNX does not contain records for DSNDB06.SYSTSCPY, DSNDB01.SYSUTILX, DSNDB01.DBD01, or DSNDB01.SYSDBDXA. You can run MODIFY RECOVERY on these table spaces, but you receive message DSNU573I, indicating that no SYSCOPY records were found. No SYSCOPY or SYSLGRNX records are deleted.

Execution phases of MODIFY RECOVERY

The MODIFY RECOVERY phase operates in these phases:

UTILINIT
Performs initialization and setup

MODIFY
Deletes records

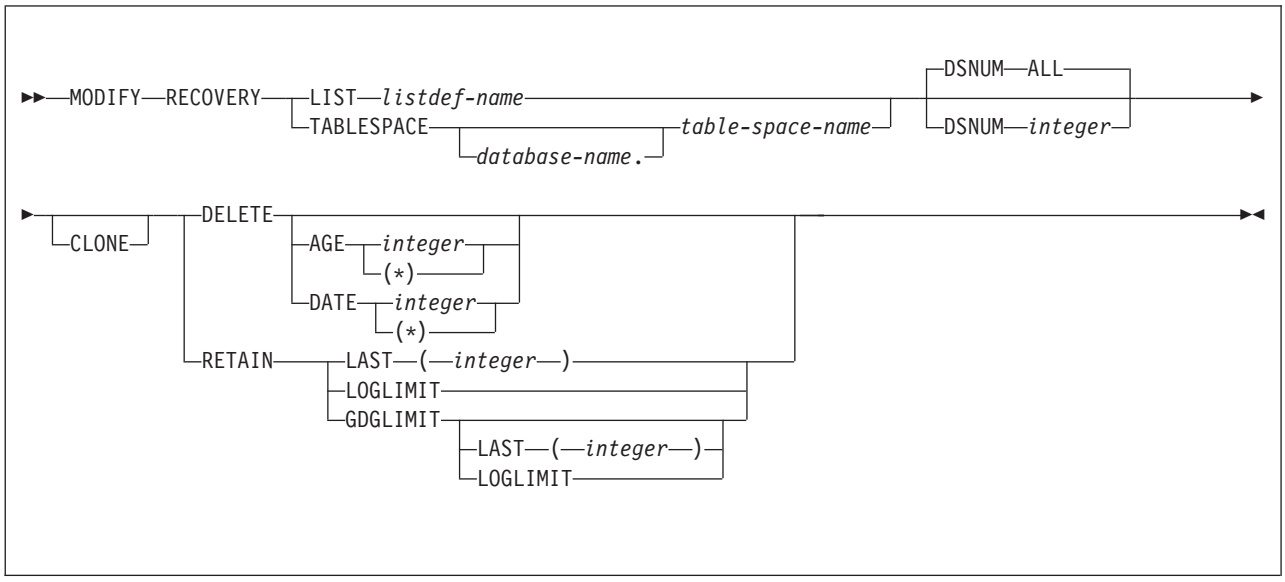
UTILTERM
Performs cleanup

Syntax and options of the MODIFY RECOVERY control statement

The MODIFY RECOVERY utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name that contains only table spaces. You can specify one LIST keyword per MODIFY RECOVERY control statement. Do not specify LIST with the TABLESPACE keyword. MODIFY is invoked once for each table space in the list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*
Specifies the database and the table space for which records are to be deleted.

database-name
Specifies the name of the database to which the table space belongs. *database-name* is optional.

The default value is **DSNDB04**.

table-space-name
Specifies the name of the table space.

DSNUM *integer*
Identifies a single partition or data set of the table space for which records are to be deleted; ALL deletes records for the entire data set and table space.

integer is the number of a partition or data set.

The default value is **ALL**.

For a partitioned table space, *integer* is its physical partition number. The maximum is 4096.

For a nonpartitioned table space, use the data set integer at the end of the data set name as cataloged in the VSAM catalog. If image copies are taken by partition or data set and you specify DSNUM ALL, the table space is placed in COPY-pending status if a full image copy of the entire table space does not exist. The data set name has the following format, where *y* is either I or J, *z* is either a 1 or 2, and *nnn* is the data set integer.

catname.DSNDB*x*.*dbname*.*tsname*.*y*000*z*.A*nnn*

If you specify DSNUM n, MODIFY RECOVERY does not delete any SYSCOPY records for the partitions that have an RBA greater than that of the earliest point to which the entire table space could be recovered. That point might indicate a full image copy, a LOAD operation with LOG YES or a REORG operation with LOG YES.

If you specify DSNUM n for a partitioned table space, MODIFY RECOVERY deletes SYSCOPY records for all partitioned index spaces as well as for the partition and updates the version numbers in the SYSIBM.SYSINDEXES catalog table. However, DB2 does not perform these functions for the nonpartitioned indexes.

If DSNUM ALL is implicitly or explicitly specified for a table space that has a partition in PRO restricted status, MODIFY RECOVERY fails. If the partition that you specify is in PRO restricted status, the RETAIN value is set to LAST(2).

CLONE
Indicates that MODIFY RECOVERY is to delete SYSCOPY records and SYSLGRNX records for only clone objects. If CLONE is not specified, only records for the base objects are deleted. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

DELETE
Indicates that records are to be deleted. See the DSNUM description for restrictions on deleting partition statistics.

AGE *integer*
Deletes all SYSCOPY and SYSLGRNX records that are older than a specified number of days. SYSLGRNX records that meet the age deletion criteria specified will be deleted even if no SYSCOPY records are deleted.

integer is the number of days, and can range from 0 to 32767. Records that are created today are of age 0 and cannot be deleted by this option.

(*) deletes all records, regardless of their age.

DATE *integer*
Deletes all SYSCOPY and SYSLGRNX records that are written before a specified date. SYSLGRNX records that meet the date deletion criteria specified will be deleted even if no SYSCOPY records are deleted.

integer can be in eight- or six-character format. You must specify a year (*yyyy* or *yy*), month (*mm*), and day (*dd*) in the form *yyyymmdd* or *yymmdd*. DB2 checks the system clock and converts six-character dates to the most recent, previous eight-character equivalent.

(*) deletes all records, regardless of the date on which they were written.

RETAIN
Indicates that records are to be retained. Older records are deleted.

To determine a cleanup date, RETAIN checks only records in SYSIBM.SYSCOPY with ICTYPE=F (full copy), ICBACKUP=blank (LOCALSITE primary copy), and DSNUM as stated for the specified table space.

RETAIN works internally with a date, not a complete timestamp. As a result, more copies might be kept than are specified by RETAIN. For example, if the most recent five copies have been taken on the same day, and RETAIN LAST (2) is specified, then all five copies remain in SYSCOPY.

LAST *(integer)*
Specifies the number of recent records to retain in SYSIBM.SYSCOPY.

LOGLIMIT
Queries the BSDS to determine the oldest archive log timestamp and deletes records older than this timestamp. For data sharing, DB2 queries the BSDS of all data sharing members to determine the overall oldest log timestamp. If the BSDS is not available for one of the members and the corresponding member is quiesced, this BSDS is ignored.

GDGLIMIT
Retrieves the limit value for the generation data group (GDG) if the most recent record in SYSIBM.SYSCOPY refers to a generation data set (GDS). DB2 retains as many records that reference the same GDG as it can without exceeding this GDG limit value. In this situation, DB2 does not consider other GDGs that are referenced by SYSIBM.SYSCOPY records. These records that reference other GDGs are deleted in accordance with the deletion date.

LAST *(integer)*
Specifies the number of recent records to retain in SYSIBM.SYSCOPY if the most recent record in SYSIBM.SYSCOPY refers to a non-GDS.

LOGLIMIT
Queries the BSDS to determine the oldest archive log timestamp if the most recent record in SYSIBM.SYSCOPY refers to a non-GDS. For data sharing, DB2 queries the BSDS of all data sharing members to determine the overall oldest log timestamp, and deletes records older than this timestamp. If the BSDS is not available for one of the members and the corresponding member is quiesced, this BSDS is ignored.

Related reference:

Chapter 19, “LISTDEF,” on page 221

Chapter 35, “TEMPLATE,” on page 789

Before running MODIFY RECOVERY

Certain activities might be required before you run the MODIFY RECOVERY utility, depending on your situation.

Before you run MODIFY RECOVERY, perform the following actions:

- Make sure that DSNDB01.SYSLGRNX is not in a restrictive state. Because MODIFY RECOVERY updates DSNDB01.SYSLGRNX as part of its routine processing, any restrictive status on this table space might cause the utility to abend.

  A prior MODIFY RECOVERY run on DSNDB01.SYSLGRNX could inadvertently lead to this situation. For example, if all recovery information was deleted by the specified age or date criteria, DSNDB01.SYSLGRNX is set to COPY-pending status.
-

  Recommendation: If you plan to use MODIFY RECOVERY to delete SYSCOPY records, first run the REPORT utility with the RECOVERY option. This utility reports all SYSCOPY records for the object at the specified site. Looking at this report first helps you avoid deleting the wrong records.
- Remove RECOVER-pending status from any table spaces on which you plan to run MODIFY RECOVERY. You cannot run MODIFY RECOVERY on a table space that is in RECOVER-pending status.
-

  Recommendation: To improve the performance of MODIFY RECOVERY and reduce contention on SYSLGRNX, run the REORG TABLESPACE utility on DSNDB01.SYSLGRNX on a regular basis.

Related concepts:

"REPORT output" on page 700

Related tasks:

"Resetting RECOVER-pending or REBUILD-pending status" on page 505

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

"Syntax and options of the REPORT control statement" on page 695

"Syntax and options of the REORG TABLESPACE control statement" on page 555

Data sets that MODIFY RECOVERY uses

The MODIFY RECOVERY utility uses a number of data sets during its operation.

The following table lists the data sets that MODIFY RECOVERY uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 55. Data sets that MODIFY RECOVERY uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space
Object for which records are to be deleted.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for MODIFY RECOVERY

The MODIFY RECOVERY utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

The following table shows the restrictive state that the utility sets on the target object.

Table 56. Claim classes of MODIFY RECOVERY operations.

Target	MODIFY RECOVERY
Table space or partition	UTRW

Legend:

UTRW - Utility restrictive state - Read-write access allowed.

MODIFY RECOVERY can run concurrently on the same target object with any utility except the following utilities:
- COPY TABLESPACE
- LOAD
- MERGECOPY
- MODIFY RECOVERY
- RECOVER TABLESPACE
- REORG TABLESPACE

The target object can be a table space or partition.

How MODIFY RECOVERY deletes rows

You can use the MODIFY RECOVERY utility to delete specific rows from DB2 catalog and directory tables in certain conditions.

Deletion of SYSLGRNX and SYSCOPY rows for a single partition or the entire table space

You can use the MODIFY RECOVERY utility to delete rows from the SYSIBM.SYSLGRNX directory table and SYSIBM.SYSCOPY catalog table. Use the DSNUM option to specify whether to delete rows for a single partition or for the entire table space. The DSNUM value that you specify (ALL or *integer*) depends on the type of image copies that exist for the table space.

Use the following guidelines to determine whether to use DSNUM ALL or DSNUM *integer*:

- If image copies exist at only the partition level, use DSNUM *integer*.

- If image copies exist at only the data set level for a nonpartitioned table space, use DSNUM ALL. If DSNUM *integer* is used, SYSLGRNX records are not deleted.
- If image copies exist at only the table space or index space level, use DSNUM ALL.
- If image copies exist at both the partition level and the table space or index space level, use DSNUM ALL.

  Restriction: In this case, if you use DSNUM *integer*, MODIFY RECOVERY does not delete any SYSCOPY or SYSLGRNX records that are newer than the oldest recoverable point at the table space or index space level.
- If image copies exist at both the data set level and the table space level for a nonpartitioned table space, use DSNUM ALL.

  Restriction: In this case, if you use DSNUM *integer*, MODIFY RECOVERY does not delete any SYSCOPY or SYSLGRNX records that are newer than the oldest recoverable point at the table space level.

The preceding guidelines pertain to all image copies, regardless of how they were created, including those copies that were created by COPY, COPYTOCOPY, LOAD, REORG TABLESPACE, or MERGECOPY.

If MODIFY RECOVERY deletes SYSCOPY or SYSLGRNX rows, it inserts a row into SYSCOPY with the following values:

- ICTYPE='M'
- STYPE='R'
- A START_RBA value that is equal to the START_RBA value of the SYSCOPY or SYSLGRNX row that was most recently deleted

However, suppose that MODIFY RECOVERY deletes SYSCOPY rows with an ICTYPE value of 'C', 'I' or 'Q' but does not delete any SYSLGRNX rows. In this case, MODIFY RECOVERY does not insert rows into SYSCOPY with the values ICTYPE='M', STYPE='R'.

Deletion of SYSLGRNX rows when no SYSCOPY rows exist

Use the AGE or DATE options when you want to delete SYSLGRNX rows and no SYSCOPY rows meet the deletion criteria. The SYSLGRNX rows are deleted based on the AGE or DATE specified. The RECOVER utility uses this information to determine whether it has all of the necessary information for the recovery of objects.

Deletion of recovery rows for indexes

When MODIFY RECOVERY processes a table space, the utility deletes SYSCOPY and SYSLGRNX rows that meet the AGE and DATE criteria for related indexes with the COPY YES attribute.

Deletion of all image copy entries

You can use MODIFY RECOVERY to delete all image copy entries for a table space or data set. In this case, MODIFY RECOVERY places the object in COPY-pending (COPY) restrictive status and issues message DSNU572I.

Deletion of SYSOBDS entries

MODIFY RECOVERY removes entries that the database manager inserts in the SYSOBDS catalog table during the materialization of pending definition changes.

When MODIFY RECOVERY is run on an entire table space, MODIFY RECOVERY removes the SYSOBDS entries after deletion of the last image copy that contains version 0 data rows or keys for the table space or associated indexes.

Related tasks:

Materializing pending definition changes (DB2 Administration Guide)

Related reference:

SYSIBM.SYSLGRNX table (DB2 SQL)

SYSIBM.SYSCOPY table (DB2 SQL)

"COPY-pending status" on page 1106

Related information:

DSNU572I (DB2 Messages)

Reclaiming space in the DBD

You can reclaim space in the DBD when you drop a table by using the MODIFY RECOVERY utility.

Procedure

To reclaim space in the DBD when you drop a table:

1. Commit the drop.
2. Run the REORG utility.
3. Run the COPY utility to make a full image copy of the table space.
4. Run the MODIFY RECOVERY utility with the DELETE or RETAIN option to delete all previous image copies.

Improving REORG performance after adding a column

After you add a column to a table space, you can take certain steps to improve performance.

About this task

After a column is added to a table space, the next REORG utility job of that table space creates default values for the new column, as follows:

- During its UNLOAD phase, the REORG job creates default values by converting all fields in each row to the external DB2 format.
- During the RELOAD phase, the REORG job then converts the default values to the internal DB2 format.

This REORG processing, referred to as a *compression cycle*, occurs on each subsequent run of the REORG utility on this table space. You can improve performance by avoiding the compression cycle each time that the REORG job runs on the table space.

Procedure

To improve performance after adding a column to a table space:

1. Run the REORG utility on the table space.
2. Run the COPY utility to make a full image copy of the table space.
3. Run MODIFY RECOVERY with the DELETE or RETAIN option to delete all previous image copies. MODIFY RECOVERY changes the status of the column that is added after using the ALTER statement only if SYSCOPY rows need to be deleted.

Termination or restart of MODIFY RECOVERY

You can terminate and restart the MODIFY RECOVERY utility.

You can use the **TERM UTILITY** command to terminate MODIFY RECOVERY in any phase without any integrity exposure.

You can restart a MODIFY RECOVERY utility job, but it starts from the beginning again.

Related tasks:

"Terminating an online utility" on page 51

"Restarting an online utility" on page 52

The effect of MODIFY RECOVERY on version numbers

When you run MODIFY RECOVERY, the utility updates the range of used version numbers for table spaces and for indexes that are defined with the COPY YES attribute.

MODIFY RECOVERY updates the OLDEST_VERSION column of the appropriate catalog table or tables with the version number of the oldest version that has not yet been applied to the entire object.

If a SYSCOPY record is deleted that has an OLDEST_VERSION number that equals the CURRENT_VERSION number of the table space or index, MODIFY RECOVERY updates the OLDEST_VERSION number in the appropriate catalog table or tables with the CURRENT_VERSION number.

DB2 can reuse any version numbers that are not in the range that is set by the values in the OLDEST_VERSION and CURRENT_VERSION columns.

DB2 stores the range of used version numbers in the OLDEST_VERSION and CURRENT_VERSION columns of one or more of the following catalog tables, depending on the object:

- SYSIBM.SYSTABLESPACE
- SYSIBM.SYSTABLEPART
- SYSIBM.SYSINDEXES
- SYSIBM.SYSINDEXPART

The OLDEST_VERSION column contains the oldest used version number, and the CURRENT_VERSION column contains the current version number.

Recycling of version numbers is required when all of the version numbers are being used. All version numbers are being used when one of the following situations is true:

- The value in the CURRENT_VERSION column is one less than the value in the OLDEST_VERSION column.
- The value in the CURRENT_VERSION column is 255 for table spaces or 15 for indexes, and the value in the OLDEST_VERSION column is 0 or 1.

To recycle version numbers for indexes that are defined with the COPY NO attribute, run LOAD REPLACE, REBUILD INDEX, REORG INDEX, or REORG TABLESPACE.

Related concepts:

Table space versions (DB2 Administration Guide)

Sample MODIFY RECOVERY control statements

Use the sample control statements as models for developing your own MODIFY RECOVERY control statements.

Example 1: Deleting SYSCOPY and SYSLGRNX records that are over a certain age

The following control statement specifies that the MODIFY RECOVERY utility is to delete all SYSCOPY and SYSLGRNX records that are older than 90 days for table space DSN8D81A.DSN8S81E.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UD.MODRCV1',
//            UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
MODIFY RECOVERY TABLESPACE DSN8D11A.DSN8S11E DELETE AGE(90)
/*
```

Example 2: Deleting SYSCOPY and SYSLGRNX records that are older than a certain date

The following control statement specifies that MODIFY RECOVERY is to delete all SYSCOPY and SYSLGRNX records that were written before 10 September 2002.

```
MODIFY RECOVERY TABLESPACE DSN8D11A.DSN8S11D DELETE DATE(20020910)
```

Example 3: Deleting SYSCOPY records for partitions

The following control statements specifies that MODIFY RECOVERY is to delete the following SYSCOPY records for table space TU5AP053:

- Any records in partition 2 that are older than 5 days
- Any records in partition 3 that were written before 9 October 2006

```
//STEP2    EXEC  DSNUPROC,UID='FUN5U053.STEP2',UTPROC='',SYSTEM='SSTR'
//SYSIN DD *

    MODIFY RECOVERY TABLESPACE TU5AP053
           DSNUM 2
           DELETE AGE(5)

    MODIFY RECOVERY TABLESPACE TU5AP053
           DSNUM 3
           DELETE DATE(061009)
/*
```

Figure 45. Example MODIFY RECOVERY statements that delete SYSCOPY records for partitions

Example 4: Deleting all SYSCOPY records for objects in a list and viewing the results

In the following example job, the LISTDEF utility control statements define three lists (L1, L2, L3). The first group of REPORT utility control statements then specify that the utility is to report recovery information for the objects in these lists. Next, the MODIFY RECOVERY control statement specifies that the utility is to delete all SYSCOPY records for the objects in the L1 list. Finally, the second group of REPORT control statements specify that the utility is to report the recovery information for the same three lists. In this second report, no information will be reported for the objects in the L1 list because all of the SYSCOPY records have been deleted.

```
//STEP4    EXEC DSNUPROC,UID='JULTU224.RCV1',
//            UTPROC='',SYSTEM='SSTR'
//SYSIN    DD *
   LISTDEF L1 INCLUDE TABLESPACE DBLT2401.T*
   LISTDEF L2 INCLUDE INDEXSPACE DBLT2401.I*
     LISTDEF  L3  INCLUDE INDEX IXLT2402
   REPORT RECOVERY TABLESPACE LIST L1
   REPORT RECOVERY INDEXSPACE LIST L2
     REPORT RECOVERY  INDEX LIST L3
   MODIFY RECOVERY LIST L1
        DELETE DATE(*)

   REPORT RECOVERY TABLESPACE LIST L1
   REPORT RECOVERY INDEXSPACE LIST L2
   REPORT RECOVERY INDEX LIST L3
/*
```

Figure 46. Example MODIFY RECOVERY statement that deletes all SYSCOPY records

Example 5: Retaining SYSCOPY and SYSLGRNX records of a GDG

The following control statement specifies that MODIFY RECOVERY is to retain as many recent records in SYSIBM.SYSCOPY as defined in the GDG limit.

```
MODIFY RECOVERY TABLESPACE DBKQBL01.TPKQBL01 RETAIN GDGLIMIT
```

Example 6: Retaining SYSCOPY and SYSLGRNX records

The following control statement specifies that MODIFY RECOVERY is to retain 4 recent records in SYSIBM.SYSCOPY.

```
MODIFY RECOVERY TABLESPACE DBKQBL01.TPKQBL01 RETAIN  LAST (4)
```

Example 7: Deleting SYSCOPY and SYSLGRNX records for clone objects

The following control statement specifies that MODIFY RECOVERY is to delete SYSCOPY records and SYSLGRNX records for only clone objects.

```
MODIFY RECOVERY TABLESPACE DBKQBL01.TPKQBL01
         CLONE
         DELETE AGE(*)
```

Related reference:

Chapter 19, “LISTDEF,” on page 221

Chapter 31, “REPORT,” on page 693

Chapter 23. MODIFY STATISTICS

The MODIFY STATISTICS online utility deletes unwanted statistics history records from the corresponding catalog tables. You can remove statistics history records that were written before a specific date, or you can remove records of a specific age. You can delete records for an entire table space, index space, or index.

Run MODIFY STATISTICS regularly to clear outdated information from the statistics history catalog tables. By deleting outdated information from those tables, you can improve performance for processes that access data from those tables.

Restriction: MODIFY STATISTICS does not delete statistics history records for clone tables because statistics are not collected for these tables.

Output

MODIFY STATISTICS deletes rows from the following catalog tables:
- SYSIBM.SYSCOLDIST_HIST
- SYSIBM.SYSCOLUMNS_HIST
- SYSIBM.SYSINDEXES_HIST
- SYSIBM.SYSINDEXPART_HIST
- SYSIBM.SYSINDEXSTATS_HIST
- SYSIBM.SYSLOBSTATS_HIST
- SYSIBM.SYSTABLEPART_HIST
- SYSIBM.SYSTABSTATS_HIST
- SYSIBM.SYSTABLES_HIST
- SYSKEYTARGETS_HIST
- SYSKEYTGTDIST_HIST

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:
- STATS privilege for the database to run MODIFY STATISTICS.
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- SQLADM authority.
- System DBADM authority.
- SYSCTRL or SYSADM authority.

A user ID with installation SYSOPR authority can also execute MODIFY STATISTICS, but only on a table space in the DSNDB01 or DSNDB06 database.

Execution phases of MODIFY STATISTICS

The MODIFY STATISTICS utility operates in these phases:

Phase Description

UTILINIT
Performs initialization and setup

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MODIFYS
Deletes records

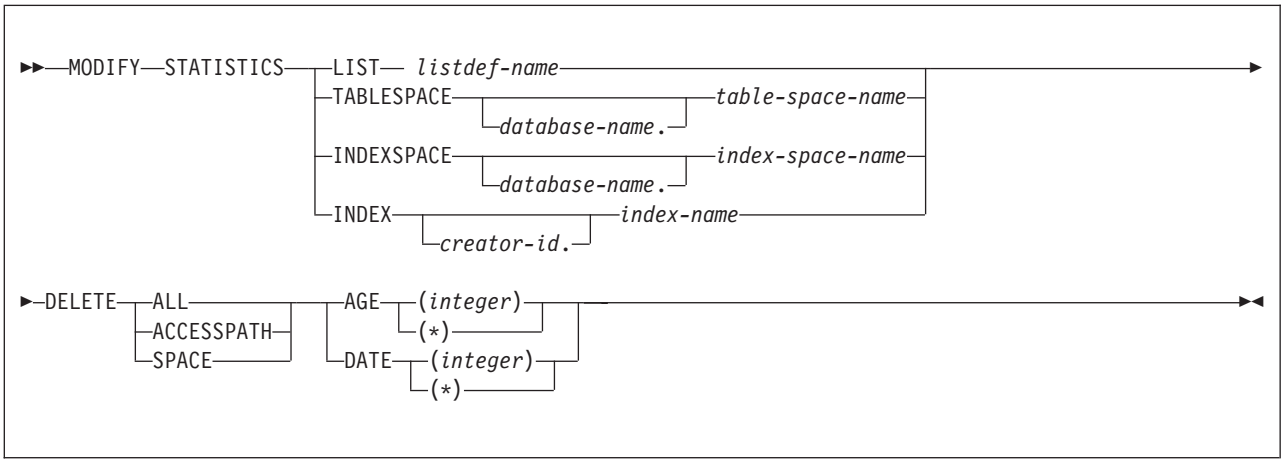
UTILTERM
Performs cleanup

Syntax and options of the MODIFY STATISTICS control statement

The MODIFY STATISTICS utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. You cannot repeat the LIST keyword or specify it with TABLESPACE, INDEXSPACE, or INDEX.

The list can contain index spaces, table spaces, or both. MODIFY STATISTICS is invoked once for each object in the list.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*
Specifies the database and the table space for which catalog history records are to be deleted.

database-name
Specifies the name of the database to which the table space belongs. *database-name* is optional.

The default value is **DSNDB04**.

table-space-name
Specifies the name of the table space for which statistics are to be deleted.

INDEXSPACE *database-name.index-space-name*
Specifies the qualified name of the index space for which catalog history information is to be deleted. The utility lists the name in the SYSIBM.SYSINDEXES table.

database-name
Optionally specifies the name of the database to which the index space belongs.

The default value is **DSNDB04**.

index-space-name
Specifies the name of the index space for which the statistics are to be deleted.

INDEX *creator-id.index-name*
Specifies the index for which catalog history information is to be deleted.

creator-id
Optionally specifies the creator of the index.

The default value is **DSNDB04**.

index-name
Specifies the name of the index for which the statistics are to be deleted. Enclose the index name in quotation marks if the name contains a blank.

DELETE
Indicates that records are to be deleted.

ALL
Deletes all statistics history rows that are related to the specified object from all catalog history tables.

Rows from the following history tables are deleted only when you specify DELETE ALL:

- SYSTABLES_HIST
- SYSTABSTATS_HIST
- SYSINDEXES_HIST
- SYSINDEXSTATS_HIST
- SYSKEYTARGETS_HIST

ACCESSPATH
Deletes all access-path statistics history rows that are related to the specified object from the following history tables:

- SYSIBM.SYSCOLDIST_HIST
- SYSIBM.SYSCOLUMNS_HIST
- SYSKEYTGTDIST_HIST

SPACE
Deletes all space-tuning statistics history rows that are related to the specified object from the following history tables:

- SYSIBM.SYSINDEXPART_HIST
- SYSIBM.SYSTABLEPART_HIST
- SYSIBM.SYSLOBSTATS_HIST

AGE (*integer***)**
Deletes all statistics history rows that are related to the specified object and that are older than a specified number of days.

(*integer*)
Specifies the number of days in a range from 0 to 32 767. This option cannot delete records that are created today (age 0).

(*)
Deletes all records, regardless of their age.

DATE (*integer*)
Deletes all statistics history rows that were written before a specified date.

(*integer*)
Specifies the date in an eight-character format. Specify a year (*yyyy*), month (*mm*), and day (*dd*) in the form *yyyymmdd*.

(*)
Deletes all records, regardless of the date on which they were written.

Data sets that MODIFY STATISTICS uses

The MODIFY STATISTICS utility uses a number of data sets during its operation.

The following table lists the data sets that MODIFY STATISTICS uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 57. Data sets that MODIFY STATISTICS uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement	Yes
SYSPRINT	Output data set for messages	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space or index space
Object for which records are to be deleted.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for MODIFY STATISTICS

The MODIFY STATISTICS utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

The following table shows the restrictive state that the utility sets on the target object.

Table 58. Claim classes of MODIFY STATISTICS operations.

Target	MODIFY STATISTICS
Table space, index, or index space	UTRW

Table 58. Claim classes of MODIFY STATISTICS operations. (continued)

Target	MODIFY STATISTICS
Legend:	
UTRW - Utility restrictive state - read-write access allowed.	

Guidelines for deciding which statistics history rows to delete

After analyzing trends by using the relevant historical catalog information and possibly taking actions based on this information, consider deleting all or part of the statistics history catalog rows.

Deleting outdated information from the statistics history catalog tables can improve performance for processes that access data from those tables. You also make available the space in the catalog. Then, the next time you update the relevant statistics by using RUNSTATS TABLESPACE, REBUILD INDEX, or REORG INDEX, DB2 repopulates the statistics history catalog tables with more recent historical data. Examining this data lets you determine the efficacy of any adjustments that you made as a result of your previous analysis.

Be aware that when you manually insert, update, or delete catalog information, DB2 does not store the historical information for those operations in the historical catalog tables.

Deletion of specific statistics history rows

The MODIFY STATISTICS utility lets you delete some or all statistics history rows for a table space, an index space, or an index.

You can choose to delete only the statistics rows that relate to access path selection by specifying the ACCESSPATH option. Alternatively, you can delete the rows that relate to space statistics by using the SPACE option. To delete rows in all statistics history catalog tables, including the SYSIBM.SYSTABLES_HIST catalog table, you must specify the DELETE ALL option in the utility control statement.

To delete statistics from the RUNSTATS history tables, you can either use the MODIFY STATISTICS utility or issue SQL DELETE statements. The MODIFY STATISTICS utility simplifies the purging of old statistics without requiring you to write the SQL DELETE statements. You can also delete rows that meet the age and date criteria by specifying the corresponding keywords (AGE and DATE) for a particular object.

To avoid time outs when you delete historical statistics with MODIFY STATISTICS, you should increase the LOCKMAX parameter for DSNDB06.SYSHIST with ALTER TABLESPACE.

Termination or restart of MODIFY STATISTICS

You can terminate and restart the MODIFY STATISTICS utility.

You can use the **TERM UTILITY** command to terminate the MODIFY STATISTICS utility in any phase.

You can restart a MODIFY STATISTICS utility job, but it starts from the beginning again.

Related tasks:

"Restarting an online utility" on page 52

Sample MODIFY STATISTICS control statements

Use the sample control statements as models for developing your own MODIFY STATISTICS control statements.

Example 1: Deleting SYSIBM.SYSTABLES_HIST records by age

The following control statement specifies that the MODIFY STATISTICS utility is delete all statistics history records for table space DSN8D81A.DSN8S81E that are older than 60 days.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UD.MODSTAT1',
//            UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
  MODIFY STATISTICS TABLESPACE DSN8D11A.DSN8S11E
    DELETE ALL
    AGE 60
/*
```

Example 2: Deleting access path records for all objects in a list

The following MODIFY STATISTICS control statement specifies that the utility is to delete access-path statistics history rows that were created before 17 April 2000 for objects in the specified list. The list, M1, is defined in the preceding LISTDEF control statement and includes table spaces DB0E1501.TL0E1501 and DSN8D81A.DSN8S81E.

```
//STEP9    EXEC DSNUPROC,UID='JUOEU115.MDFYL9',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *

   LISTDEF M1 INCLUDE TABLESPACE DBOE1501.TLOE1501
              INCLUDE TABLESPACE DSN8D81A.DSN8S81E
   MODIFY STATISTICS LIST M1
                     DELETE ACCESSPATH DATE(20000417)
/*
```

Figure 47. MODIFY STATISTICS control statement that specifies that access path history records are to be deleted

Example 3: Deleting space-tuning statistics records for an index by age

The following control statement specifies that MODIFY STATISTICS is to delete space-tuning statistics records for index ADMF001.IXOE15S1 that are older than one day.

```
//STEP9    EXEC DSNUPROC,UID='JUOEU115.MOFYS9',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *

   MODIFY STATISTICS INDEX ADMF001.IXOE15S1
                     DELETE SPACE AGE 1
/*
```

Figure 48. MODIFY STATISTICS control statement that specifies that space-tuning statistics records are to be deleted

Example 4: Deleting all statistics history records for an index space

The following control statement specifies that MODIFY STATISTICS is to delete all statistics history records for index space DBOE1501.IUOE1501. Note that the deleted records are not limited by date because (*) is specified.

```
//STEP8    EXEC DSNUPROC,UID='JUOEU115.MDFYL8',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
   MODIFY STATISTICS INDEXSPACE DBOE1501.IUOE1501
                     DELETE ALL DATE (*)
/*
```

Figure 49. MODIFY STATISTICS control statement that specifies that all statistics history records are to be deleted

Chapter 24. OPTIONS

The OPTIONS online utility control statement specifies processing options that are applicable across many utility executions in a job step.

By specifying various options, you can:

- Preview utility control statements
- Preview LISTDEF or TEMPLATE definitions
- Override library names for LISTDEF lists or TEMPLATE definitions
- Specify how to handle errors during list processing
- Alter the return code for warning messages
- Restore all default options

You can repeat an OPTIONS control statement within the SYSIN DD statement. If you repeat the control statement, it entirely replaces any prior OPTIONS control statement.

Output

The OPTIONS control statement sets the specified processing options for the duration of the job step, or until replaced by another OPTIONS control statement within the same job step.

Authorization required

The OPTIONS control statement performs setup for subsequent control statements. The OPTIONS statement itself requires no privileges to execute.

Execution phases of OPTIONS

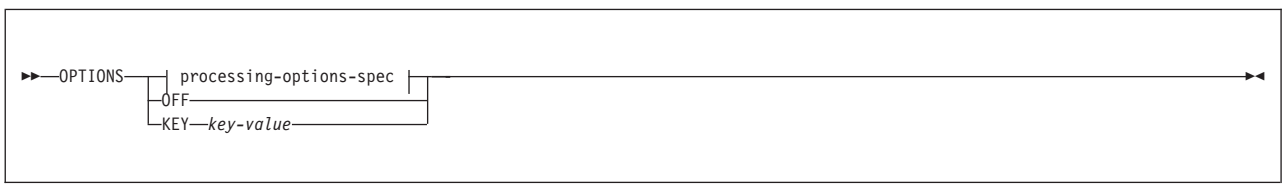
The OPTIONS control statement executes entirely in the UTILINIT phase, in which it performs setup for the subsequent utility.

Syntax and options of the OPTIONS control statement

The OPTIONS utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



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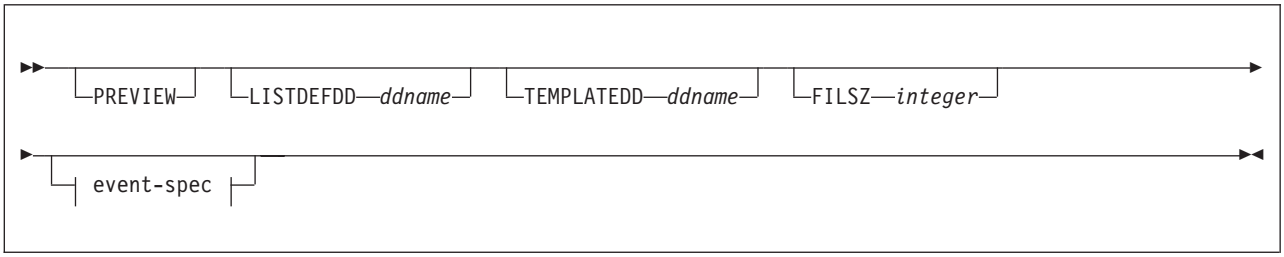
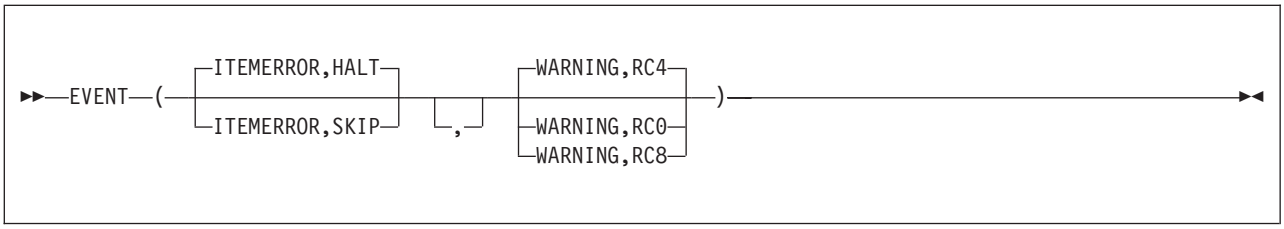
processing-options-spec:



event-spec:



Option descriptions

PREVIEW

Specifies that the utility control statements that follow are to run in PREVIEW mode. The utility checks for syntax errors in all utility control statements, but normal utility execution does not take place. If the syntax is valid, the utility expands all LISTDEF lists and TEMPLATE DSNs that appear in SYSIN and prints results to the SYSPRINT data set.

PREVIEW evaluates and expands all LISTDEF statements into an actual list of table spaces or index spaces. It evaluates TEMPLATE DSNs and uses variable substitution for actual data set names when possible. It also expands lists from the SYSLISTD DD and TEMPLATE DSNs from the SYSTEMPL DD that a utility invocation references.

A definitive preview of TEMPLATE DSN values is not always possible. Substitution values for some variables, such as &DATE., &TIME., &SEQ. and &PART., can change at execution time. In some cases, PREVIEW generates approximate data set names. The OPTIONS utility substitutes unknown character variables with the character string "UNKNOWN" and unknown integer variables with zeroes.

Instead of OPTIONS PREVIEW, you can use a JCL PARM to activate preview processing. Although the two functions are identical, use JCL PARM to preview an existing set of utility control statements. Use the OPTION PREVIEW control statement when you invoke DB2 utilities through a stored procedure.

The JCL PARM is specified as the third JCL PARM of DSNUTILB and on the UTPROC variable of DSNUPROC, as shown in the following JCL:

```
//STEP1    EXEC DSNUPROC,UID='JULTU106.RECOVE1',
//         UTPROC='PREVIEW',SYSTEM='SSTR'
```

The PARM value PREVIEW causes the utility control statements in that job step to be processed for preview only. The LISTDEF and TEMPLATE control statements are expanded, but the utility does not execute.

OPTIONS PREVIEW is identical to the PREVIEW JCL parameter, except that you can specify a subsequent OPTIONS statement to turn off the preview for OPTIONS PREVIEW. Absence of the PREVIEW keyword in the OPTION control statement turns off preview processing, but it does not override the PREVIEW JCL parameter, which, if specified, remains in effect for the entire job step.

LISTDEFDD *ddname*
Specifies the *ddname* of the LISTDEF definition library. A LISTDEF library is a data set that contains only LISTDEF utility control statements. This data set is processed only when a referenced LIST is not found in SYSIN.

The default value is **SYSLISTD**.

TEMPLATEDD *ddname*
Specifies the *ddname* of the TEMPLATE definition library. A TEMPLATE library is a data set that contains only TEMPLATE utility control statements. This data set is processed only when a referenced name does not exist in the job step as a DD name and is not found in SYSIN as a TEMPLATE name.

The default value is **SYSTEMPL**.

FILSZ *integer*
Specifies a file size in megabytes and overrides the file size for the sort program when sort work data sets are allocated by the utility with system parameter UTSORTAL set to YES. Only use this keyword under the direction of IBM Software Support.

EVENT
Specifies one or more pairs of utility processing events and the matching action for the event. Not all actions are valid for all events.

The parentheses and commas in the EVENT operand are currently optional but they may be required in a future release.

ITEMERROR

Specifies how utility processing is to handle errors during list processing. Specifically, this keyword indicates the effect on processing in response to return code 8. By default, utility processing stops (HALT). The ITEMERROR event does not include abnormal terminations (abends).

Note that for the QUIESCE utility, the indexes for the table spaces in the list, if any, are considered as list items for the purposes of the ITEMERROR event. ITEMERROR affects how errors are handled on both the table spaces and the indexes.

HALT
Specifies that the utility is to stop after the event.

SKIP
Ignores the event and skips the list item. Processing continues with the next item in the list.

SKIP applies only during the processing of a valid list. SKIP does not apply if a utility detects that a list is not valid for the utility that is invoked. In that case, the list is rejected with an error message and the processing of the list is not initiated.

If any of the items in a list is skipped, the utility produces a return code of 8, which terminates the job step. The following code shows an OPTIONS statement with the SKIP option:

```
OPTIONS EVENT (ITEMERROR, SKIP)
COPY LISTA
COPY LISTB
```

If LISTA contains ten objects and one object produces a return code 8 during the COPY, the other nine objects in the list are copied successfully. The job step ends with a return code 8 and COPY LISTB is not executed.

WARNING
Specifies a response to the return code message event.

Use WARNING to alter the return code for warning messages. You can alter the return code from message DSNU010I with this option. If you alter the message return code, message DSNU1024I is issued to document the new return code.

Action choices are as follows:

RC0
Lowers the final return code of a single utility invocation that ends in a return code 4 to a return code of 0. Use RC0 to force a return code of 0 for warning messages.

Use this option only when return code 4 is expected, is acceptable, and other mechanisms are in place to validate the results of a utility execution.

RC4
Specifies that return codes for warning messages are to remain unchanged. Use RC4 to override a previous OPTIONS WARNING specification in the same job step.

RC8
Raises the final return code of a single utility invocation that ends in a return code 4 to a return code of 8. Use RC8 to force a return code of 8 for warning messages. The return code of 8 causes the job step to terminate and subsequent utility control statements are not executed.

OFF
Specifies that all default options are to be restored. OPTIONS OFF does not override the PREVIEW JCL parameter, which, if specified, remains in effect for the entire job step. You cannot specify any other OPTIONS keywords with OPTIONS OFF.

OPTIONS OFF is equivalent to OPTIONS LISTDEFDD SYSLISTD TEMPLATEDD SYSTEMPL EVENT (ITEMERROR, HALT, WARNING, RC4).

KEY
Specifies an option that you should use only when you are instructed by IBM Software Support. OPTIONS KEY is followed by a single operand that IBM Software Support provides when needed.

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Concurrency and compatibility for OPTIONS

The OPTIONS utility has certain concurrency and compatibility characteristics associated with it.

OPTIONS is a utility control statement that you can use to set up an environment for another utility to follow. The OPTIONS statement is stored until a specific utility references the statement. When referenced by another utility, the list is expanded. At that time, the concurrency and compatibility restrictions of that utility apply, with the additional restriction that the catalog tables that are necessary to expand the list must be available for read-only access.

Executing statements in preview mode

You can execute utility control statements in preview mode. The utility checks for syntax errors in all utility control statements, but normal utility execution does not occur.

About this task

Statistics profiles can be previewed using the PREVIEW option. Under normal execution, statistics profiles are stored in the SYSIBM.SYSTABLES_PROFILES catalog table. When executing RUNSTATS with the PREVIEW option, DB2 only prints the statistics profile for each table to SYSPRINT and normal utility execution does not take place.

Please note that the profile text is displayed prior to parsing for syntactical errors.

The contents of the profile is displayed using DSNU1376I.

Procedure

To execute utility control statements in preview mode:

Specify the PREVIEW option in the OPTIONS control statement. Control statements are previewed for use with LISTDEF lists and TEMPLATE definitions but the specified options are not actually executed.

Related reference:

"Syntax and options of the RUNSTATS control statement" on page 739

Specifying LISTDEF and TEMPLATE libraries

You can override the names of the optional library data sets.

Procedure

To specify LISTDEF and TEMPLATE libraries:

Specify the LISTDEFDD option and the TEMPLATEDD option in the OPTIONS control statement to override the names of the optional library data sets.

Related tasks:

"Creating LISTDEF libraries" on page 236

Related reference:

Chapter 19, "LISTDEF," on page 221

Overriding standard utility processing behavior

You can alter settings for warning return codes and error handling during list processing.

Procedure

To override standard utility processing behavior:

Specify the EVENT option in the OPTIONS control statement.

Termination or restart of OPTIONS

You can terminate and restart the OPTIONS utility.

You can terminate an OPTIONS utility job by using the **TERM UTILITY** command if you submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart an OPTIONS utility job, but it starts from the beginning again. If you are restarting this utility as part of a larger job in which OPTIONS completed successfully, but a later utility failed, do not change the OPTIONS utility control statement, if possible. If you must change the OPTIONS utility control statement, use caution; any changes can cause the restart processing to fail. For example, if you specify a valid OPTIONS statement in the initial invocation, and then on restart, specify OPTIONS PREVIEW, the job fails.

Related tasks:

"Restarting an online utility" on page 52

Sample OPTIONS control statements

Use the sample control statements as models for developing your own OPTIONS control statements.

Example 1: Checking control statement syntax and previewing lists and TEMPLATE data set names

The following OPTIONS utility control statement specifies that the subsequent utility control statements are to run in PREVIEW mode. In PREVIEW mode, DB2 checks for syntax errors in all utility control statements, but normal utility execution does not take place. If the syntax is valid, DB2 expands the CPYLIST list and the data set names in the COPYLOC and COPYREM TEMPLATE utility control statements and prints these results to the SYSPRINT data set.

```
OPTIONS PREVIEW
TEMPLATE COPYLOC UNIT(SYSDA)
         DSN(&DB..&TS..D&JDATE..&STEPNAME..COPY&IC.&LOCREM.&PB.)
         DISP(NEW,CATLG,CATLG) SPACE(200,20) TRK
         VOLUMES(SCR03)
TEMPLATE COPYREM UNIT(SYSDA)
         DSN(&DB..&TS..&UT..T&TIME..COPY&IC.&LOCREM.&PB.)
         DISP(NEW,CATLG,CATLG) SPACE(100,10) TRK
LISTDEF CPYLIST INCLUDE TABLESPACES DATABASE DBLT0701
COPY LIST CPYLIST FULL YES
     COPYDDN(COPYLOC,COPYLOC)
     RECOVERYDDN(COPYREM,COPYREM)
     SHRLEVEL REFERENCE
```

Figure 50. Example OPTIONS statement for checking syntax and previewing lists and templates.

Example 2: Specifying LISTDEF and TEMPLATE definition libraries

In the following example, the OPTIONS control statements specify the DD names of the LISTDEF definition libraries and the TEMPLATE definition libraries.

The first OPTIONS statement specifies that the LISTDEF definition library is identified by the V1LIST DD statement and the TEMPLATE definition library is identified by the V1TEMPL DD statement. These definition libraries apply to the subsequent COPY utility control statement. Therefore, if DB2 does not find the PAYTBSP list in SYSIN, it searches the V1LIST library, and if DB2 does not find the PAYTEMP1 template in SYSIN, it searches the V1TEMP library.

The second OPTIONS statement is similar to the first, but it identifies different libraries and applies to the second COPY control statement. This second COPY control statement looks similar to the first COPY job. However, this statement processes a different list and uses a different template. Whereas the first COPY job uses the PAYTBSP list from the V1LIST library, the second COPY job uses the PAYTBSP list from the V2LIST library. Also, the first COPY job uses the PAYTEMP1 template from the V1TEMPL library, the second COPY job uses the PAYTEMP1 template from the V2TEMPL library.

```
OPTIONS LISTDEFDD V1LIST TEMPLATEDD V1TEMPL
COPY LIST PAYTBSP COPYDDN(PAYTEMP1,PAYTEMP1)

OPTIONS LISTDEFDD V2LIST TEMPLATEDD V2TEMPL
COPY LIST PAYTBSP COPYDDN(PAYTEMP1,PAYTEMP1)
```

Example 3: Forcing a return code 0

In the following example, the first OPTIONS control statement forces a return code of 0 for the subsequent MODIFY RECOVERY utility control statement. Ordinarily, this statement ends with a return code of 4 because it specifies that DB2 is to delete all SYSCOPY and SYSLGRNX records for table space A.B. The second OPTIONS control statement restores the default options, so that no return codes will be overridden for the second MODIFY RECOVERY control statement.

```
OPTIONS EVENT(WARNING,RC0)
MODIFY RECOVERY TABLESPACE A.B DELETE AGE(*)
OPTIONS OFF
MODIFY RECOVERY TABLESPACE C.D DELETE AGE(30)
```

Example 4: Checking syntax and skipping errors while processing list objects

In the following control statement, the first OPTIONS utility control statement specifies that the subsequent utility control statements are to run in PREVIEW mode. In PREVIEW mode, DB2 checks for syntax errors in all utility control statements, but normal utility execution does not take place. If the syntax is valid, DB2 expands the three lists (LIST1_LISTDEF, LIST2_LISTDEF, and LIST3_LISTDEF) and prints these results to the SYSPRINT data set.

The second OPTIONS control statement specifies how DB2 is to handle return codes of 8 in any subsequent utility statements that process a valid list. If processing of a list item produces return code 8, DB2 skips that item, and continues to process the rest of the items in the list, but DB2 does not process the next utility control statement. Instead, the job ends with return code 8.

```
OPTIONS PREVIEW
LISTDEF COPY1_LISTDEF
            INCLUDE TABLESPACES TABLESPACE DSNDB01.SPT01
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSGPAUT
            INCLUDE TABLESPACES TABLESPACE DBA91302.T?A9132*
LISTDEF COPY2_LISTDEF
            INCLUDE TABLESPACES TABLESPACE DBA91303.TLA9133A
            INCLUDE TABLESPACES TABLESPACE DBA91303.TSA9133B
            INCLUDE TABLESPACES TABLESPACE DBA91303.TPA9133C
            INCLUDE TABLESPACES TABLESPACE DBA91304.TLA9134A
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSUSER
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSSTATS
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSDDF
LISTDEF COPY3_LISTDEF
            INCLUDE TABLESPACES TABLESPACE DBA91304.TSA9134B
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSHIST
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSGRTNS
            INCLUDE TABLESPACES TABLESPACE DSNDB06.SYSJAVA
            INCLUDE TABLESPACES TABLESPACE DBA91304.TPA9134C
OPTIONS EVENT(ITEMERROR,SKIP)
TEMPLATE TMP1 UNIT(SYSDA) DISP(MOD,CATLG,CATLG)
         VOLUMES(SCR03)
         DSN(DH109013.&TS..COPY&ICTYPE.&LOCREM.&PRIBAC.)
COPY LIST COPY1_LISTDEF SHRLEVEL REFERENCE
     COPYDDN (TMP1)
     RECOVERYDDN (TMP1)
     FULL YES
COPY LIST COPY2_LISTDEF SHRLEVEL REFERENCE
     COPYDDN (TMP1,TMP1)
     FULL YES
COPY LIST COPY3_LISTDEF SHRLEVEL REFERENCE
     COPYDDN (TMP1,TMP1)
     RECOVERYDDN (TMP1,TMP1)
     FULL YES
```

Figure 51. Example OPTIONS statements for checking syntax and skipping errors

Chapter 25. QUIESCE

The QUIESCE utility establishes a quiesce point for a table space, partition, table space set, or list of table spaces and table space sets. A *quiesce point* is a point at which data is consistent across these objects. You can later recover a table space to its quiesce point by using the RECOVER utility.

Output

When you request that the QUIESCE utility take a quiesce point, the quiesce point is the current log RBA or log record sequence number (LRSN). QUIESCE then records the quiesce point in the SYSIBM.SYSCOPY catalog table.

A quiesce point is not essential when you plan for point-in-time recoveries. The RECOVER utility can recover data to a prior point-in-time with consistency without a quiesce point. The utility can recover objects with transactional consistency, which means that the objects contain only data that has been committed. However, recovering objects to a quiesce point can be faster because no work must be backed out. You might also want to establish quiesce points for related sets of objects if you need to plan for a point-in-time recovery for the entire set.

Related information:

"Point-in-time recovery" on page 494

"Common quiesce points" on page 421

With the WRITE(YES) option, QUIESCE writes changed pages for the table spaces and their indexes from the DB2 buffer pool to disk. The catalog table SYSCOPY records the current RBA and the timestamp of the quiesce point. A row with ICTYPE='Q' is inserted into SYSIBM.SYSCOPY for each table space that is quiesced. DB2 also inserts a SYSCOPY row with ICTYPE='Q' for any indexes (defined with the COPY YES attribute) over a table space that is being quiesced. (Table spaces DSNDB06.SYSTSCPY, DSNDB01.DBD01, DSNDB01.SYSUTILX, and DSNDB01.SYSDBDXA are an exception; their information is written to the log.)

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

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Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:
- IMAGCOPY privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute QUIESCE, but only on a table space in the DSNDB01 or DSNDB06 database.

You can specify DSNDB01.SYSUTILX, but you cannot include it in a list with other table spaces to be quiesced. Recovery to the current catalog and directory table spaces is preferred and recommended. However, if you want a point-in-time recovery of the catalog and directory table spaces, a separate quiesce of DSNDB06.SYSTSCPY is required after a quiesce of the other catalog and directory table spaces.

Execution phases of QUIESCE

The QUIESCE utility operates in these phases:

Phase Description

UTILINIT
Initialization and setup

QUIESCE
Determining the quiesce point and updating the catalog

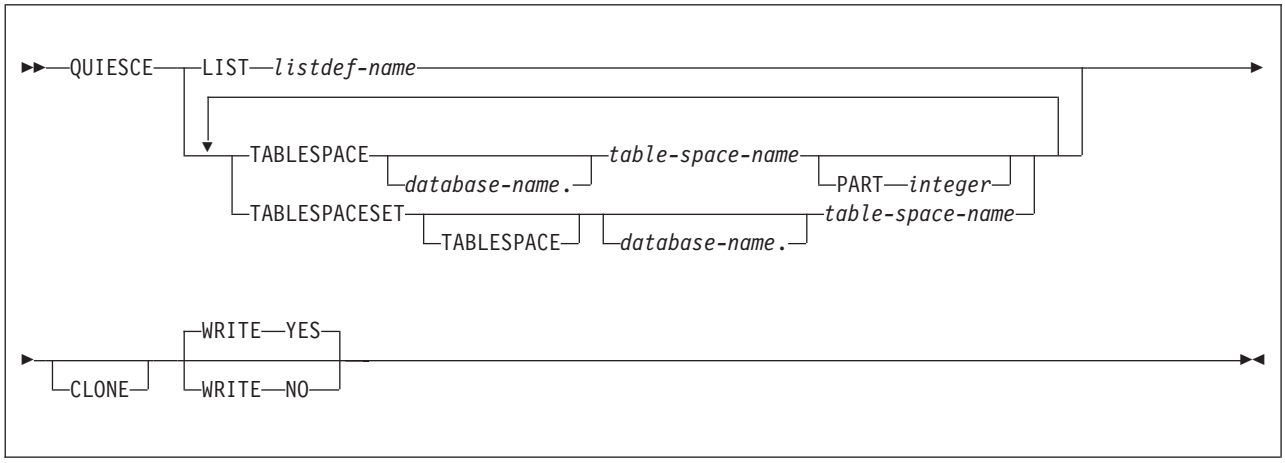
UTILTERM
Cleanup

Syntax and options of the QUIESCE control statement

The QUIESCE utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After you create the statement, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

The purpose of most of the QUIESCE control statement options is to specify which objects to quiesce. You can specify as many objects in your QUIESCE job as allowed by available memory in the batch address space and in the DB2 DBM1 address space. If you specify a table space more than once, utility processing continues, and the table space is quiesced only once. QUIESCE issues return code 4 and warning message DSNU533I to alert you of the duplication.

Use the following options to specify which objects to quiesce:

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name that contains only table spaces. The utility allows one LIST keyword for each QUIESCE control statement. Do not specify LIST with the TABLESPACE or TABLESPACESET keyword. QUIESCE is invoked once for the entire list. For the QUIESCE utility, the related index spaces are considered to be list items for the purposes of OPTIONS ITEMERROR processing. You can alter the utility behavior during processing of related indexes with the OPTIONS ITEMERROR statement. This utility processes clone data only if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*
For QUIESCE TABLESPACE, specifies the table space that is to be quiesced.

For QUIESCE TABLESPACESET, specifies a table space in the table space set that is to be quiesced. For QUIESCE TABLESPACESET, the TABLESPACE keyword is optional.

database-name
Optionally specifies the name of the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name

Specifies the name of the table space that is to be quiesced. You can specify DSNDB01.SYSUTILX, but do not include that name in a list with other table spaces that are to be quiesced. If a point-in-time recovery is planned

for the catalog and directory, DSNDB06.SYSTSCPY must be quiesced separately after all other catalog and directory table spaces.

All table spaces that are involved in a versioning relationship are quiesced when QUIESCE is run on either the system-period temporal table or the history table space. Auxiliary LOB and XML table spaces on both system-period temporal table spaces and history table spaces are included.

PART *integer*
Identifies a partition that is to be quiesced.

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

If you specify the same table space twice in a list and use PART *n* in one specification and PART *m* in the other specification, each partition is quiesced once.

TABLESPACESET
Indicates that all of the referentially related table spaces in the table space set are to be quiesced. For the purposes of the QUIESCE utility, a table space set includes the following sets of objects:

- A group of table spaces that are related through referential constraints
- A base table space with all of its LOB table spaces
- A base table space with all of its XML table spaces
- A table space with a system-period temporal table and the table space with the related history table
- A table space that includes an archive-enabled table and the table space that contains the associated archive table

Each table space set that you specify is expanded into a list of these related table spaces.

Related information:

"Common quiesce points" on page 421

Archive-enabled tables and archive tables (Introduction to DB2 for z/OS)

CLONE
Indicates that QUIESCE is to create a quiesce point for only the specified clone table space. This utility processes clone data only if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

Use the following option to control the behavior of QUIESCE:

WRITE
Specifies whether the changed pages from the table spaces and index spaces are to be written to disk.

YES
Establishes a quiesce point and writes the changed pages from the table spaces and index spaces to disk.

NO Establishes a quiesce point but does not write the changed pages from the table spaces and index spaces to disk.

Table spaces with the NOT LOGGED attribute are not quiesced.

Before running QUIESCE

Certain activities might be required before you run the QUIESCE utility, depending on your situation.

You cannot run QUIESCE on a table space that is in COPY-pending, CHECK-pending, RECOVER-pending, or auxiliary CHECK-pending status.

Related concepts:

"Resetting COPY-pending status" on page 353

"Resetting REBUILD-pending status" on page 354

Related tasks:

"Resetting CHECK-pending status" on page 102

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

Data sets that QUIESCE uses

The QUIESCE utility uses a number of data sets during its operation.

The following table lists the data sets that QUIESCE uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 59. Data sets that QUIESCE uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space
Object that is to be quiesced. (If you want to quiesce only one partition of a table space, you must use the PART option in the control statement.)

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for QUIESCE

The QUIESCE utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims

The following table shows which claim classes QUIESCE drains and any restrictive state that the utility sets on the target object.

Table 60. Claim classes of QUIESCE operations.

Target	WRITE YES	WRITE NO
Table space or partition	DW/UTRO	DW/UTRO
Partitioning index, data-partitioned secondary index, or partition	DW/UTRO	
Nonpartitioned secondary index	DW/UTRO	

Legend:
- DW - Drain the write claim class - concurrent access for SQL readers
- UTRO - Utility restrictive state - read-only access allowed

Compatibility

The following table shows which utilities can run concurrently with QUIESCE on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also documented in the table. QUIESCE does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

Table 61. Compatibility of QUIESCE with other utilities

Action	Compatible with QUIESCE?
CHECK DATA DELETE NO	Yes
CHECK DATA DELETE YES	No
CHECK INDEX	Yes
CHECK LOB	Yes
COPY INDEXSPACE SHRLEVEL CHANGE	No
COPY INDEXSPACE SHRLEVEL REFERENCE	Yes
COPY TABLESPACE SHRLEVEL CHANGE	No
COPY TABLESPACE SHRLEVEL REFERENCE	Yes
DIAGNOSE	Yes
LOAD	No
MERGECOPY	Yes
MODIFY	Yes
QUIESCE	Yes
REBUILD INDEX	No
RECOVER INDEX	No
RECOVER TABLESPACE	No
REORG INDEX	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes
REPAIR DELETE or REPLACE	No
REPAIR DUMP or VERIFY	Yes
REPORT	Yes
RUNSTATS	Yes
STOSPACE	Yes

Table 61. Compatibility of QUIESCE with other utilities (continued)

Action	Compatible with QUIESCE?
UNLOAD	Yes

To run the QUIESCE utility on DSNDB01.SYSUTILX, ensure that QUIESCE is the only utility in the job step.

QUIESCE on SYSUTILX is an exclusive job; such a job can interrupt another job between job steps, possibly causing the interrupted job to time out.

Use of QUIESCE on catalog and directory objects

Running the QUIESCE utility on the catalog and directory table spaces makes these objects unavailable for any updates during the utility execution. Therefore, this action can have a severe, adverse impact on your system's availability.

Running QUIESCE on the catalog and directory table spaces is not necessary to prepare for point-in-time recovery. The RECOVER utility can recover data to a point in time with consistency without a quiesce point.

If system availability is not a concern or you have planned for it, and you want a quiesce point on the catalog and directory table spaces, run QUIESCE on these table spaces. Adhere to the following requirements:

- You can quiesce DSNDB01.SYSUTILX, but DSNDB01.SYSUTILX must be the only table space in the QUIESCE utility control statement.
- A separate QUIESCE control statement for DSNDB06.SYSTSCPY is required after you quiesce the other catalog and directory table spaces. This separate quiesce is needed to ensure that a subsequent point-in-time recovery of DSNDB06.SYSTSCPY recovers all of the SYSCOPY records for QUIESCE operations for the other catalog and directory objects.

Related concepts:

"Point-in-time recovery" on page 494

Common quiesce points

A *common quiesce point* is a point at which data is consistent across related table spaces as a result of running the QUIESCE utility. Although establishing such a quiesce point is not required for point-in-time recoveries, doing so can improve recovery time and ensure consistency for sets of related objects.

A quiesce point is not essential for point-in-time recoveries. Additional methods exist for ensuring that objects are recovered to a consistent state, without any uncommitted data. You can recover objects to any RBA or LRSN by using the TORBA or TOLOGPOINT options on the RECOVER utility statement. In this case, RECOVER automatically handles any uncommitted units of work to ensure that the data is left in a consistent state. You can also recover to an image copy that was taken with SHRLEVEL REFERENCE. This image copy serves as a point of consistency.

However, recovering objects to a quiesce point can be faster than recovering to any RBA or LRSN, because no work has to be backed out. Also, you might want to establish quiesce points for related sets of objects if you need to plan for

point-in-time recovery for the entire set. For point-in-time recoveries, all objects in a table space set need to be recovered to the same point in time.

To obtain a common quiesce point for related table spaces, use the QUIESCE utility with the TABLESPACESET option. For the purposes of the QUIESCE utility, a table space set includes the following sets for objects:

- A group of table spaces that have a referential relationship
- A base table space with all of its LOB table spaces
- A base table space with all of its XML table spaces
- A table space with a system-period temporal table and the table space with the related history table
- A table space that includes an archive-enabled table and the table space that contains the associated archive table

If you use QUIESCE TABLESPACE instead and do not include every member of the table space set, you might have problems when you run RECOVER on table spaces in the set. RECOVER checks if a complete table space set is recovered to a single point in time. If the complete table space set is not recovered to a single point in time, RECOVER places all dependent table spaces in CHECK-pending (CHKP) status.

When you use QUIESCE WRITE YES on a table space, the utility records the quiesce point in SYSIBM.SYSCOPY. QUIESCE inserts a SYSCOPY row that specifies ICTYPE='Q' for each related index that is defined with COPY=YES.

Related concepts:

"Point-in-time recovery" on page 494

Archive-enabled tables and archive tables (Introduction to DB2 for z/OS)

Related reference:

"Syntax and options of the QUIESCE control statement" on page 416
"CHECK-pending status" on page 1105

SYSIBM.SYSCOPY table (DB2 SQL)

Running QUIESCE on a table space in pending status

When you run QUIESCE on a table space in a pending status, the output will contain various messages.

If you run QUIESCE on a table space in COPY-pending, CHECK-pending, or RECOVER-pending status, it terminates with messages that are similar to those messages shown in the following figure.

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = R92341Q
DSNU050I    DSNUGUTC - QUIESCE TABLESPACE UTQPD22A.UTQPS22D
                               TABLESPACE UTQPD22A.UTQPS22E
                               TABLESPACE UTQPD22A.EMPPROJA
DSNU471I % DSNUQUIA COPY PENDING ON TABLESPACE UTQPD22A.EMPPROJA PROHIBITS
           PROCESSING
DSNU012I DSNUGBAC - UTILITY EXECUTION TERMINATED, HIGHEST RETURN CODE=8
```

Figure 52. Termination messages when you run QUIESCE on a table space with pending restrictions

When you run QUIESCE on a table space or index space that is in COPY-pending, CHECK-pending, or RECOVER-pending status, you might also receive one or

more of the messages that are shown in the following figure.

```
DSNU202I csect RECOVER PENDING ON TABLESPACE... PROHIBITS PROCESSING
DSNU203I csect  RECOVER PENDING ON INDEX ... PROHIBITS PROCESSING
DSNU204I csect  PAGESET REBUILD PENDING ON INDEX ... PROHIBITS PROCESSING
DSNU208I csect   GROUP BUFFER POOL RECOVER PENDING ON INDEX ... PROHIBITS PROCESSING
DSNU209I  csect  RESTART PENDING ON ... PROHIBITS PROCESSING
DSNU210I  csect  INFORMATIONAL COPY PENDING ON INDEX ... PROHIBITS PROCESSING
DSNU211I  csect  CHECK PENDING ON  ... PROHIBITS PROCESSING
DSNU214I  csect  REBUILD PENDING ON INDEX ... PROHIBITS PROCESSING
DSNU215I  csect  REFRESH PENDING ON  ... PROHIBITS PROCESSING
DSNU471I  csect  COPY PENDING ON TABLESPACE ... PROHIBITS PROCESSING
DSNU568I  csect  INDEX ... IS IN INFORMATIONAL COPY PENDING
```

Figure 53. Messages for pending restrictions on QUIESCE

Reasons why QUIESCE fails to write to disk

The QUIESCE utility attempts to write pages of each table space to disk. Any of the following conditions can cause this write to fail:

- The table space has a write error range.
- The table space has deferred restart pending.
- An I/O error occurs.

If any of the preceding conditions occur, QUIESCE terminates with a return code of 4 and issues a DSNU473I warning message.

Related information:

DSNU473I (DB2 Messages)

Termination and restart of QUIESCE

You can terminate and restart the QUIESCE utility.

If you use **TERM UTILITY** to terminate QUIESCE when it is active, QUIESCE releases the drain locks on table spaces. If QUIESCE is stopped, the drain locks have already been released.

You can restart a QUIESCE utility job, but it starts from the beginning again.

QUIESCE specifies whether the changed pages from the table spaces and index spaces are to be written to disk. The default option, YES establishes a quiesce point and writes the changed pages from the table spaces and index spaces to disk. The NO option establishes a quiesce point, but does not write the changed pages from the table spaces and index spaces to disk. QUIESCE is not performed on table spaces with the NOT LOGGED attribute.

Related tasks:

"Restarting an online utility" on page 52

Sample QUIESCE control statements

Use the sample control statements as models for developing your own QUIESCE control statements.

Example 1: Establishing a quiesce point for three table spaces

The following control statement specifies that the QUIESCE utility is to establish a quiesce point for table spaces DSN8D81A.DSN8S81D, DSN8D81A.DSN8S81E, and DSN8D81A.DSN8S81P.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UD.QUIESC2',
//            UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
QUIESCE TABLESPACE DSN8D11A.DSN8S11D
        TABLESPACE DSN8D11A.DSN8S11E
        TABLESPACE DSN8D11A.DSN8S11P
//*
```

The following example shows the output that the preceding command produces.

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = TEMP
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  QUIESCE TABLESPACE DSN8D81A.DSN8S81D
                            TABLESPACE DSN8D81A.DSN8S81E
                            TABLESPACE DSN8D81A.DSN8S81P
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81D
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81E
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81P
DSNU474I  = DSNUQUIA - QUIESCE AT RBA 000004E43B78 AND AT LRSN 000004E43B78
DSNU475I    DSNUQUIB - QUIESCE UTILITY COMPLETE, ELAPSED TIME= 00:00:02
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 54. Example output from a QUIESCE job that establishes a quiesce point for three table spaces

Example 2: Establishing a quiesce point for a list of objects

In the following example, the QUIESCE control statement uses a list to specify that the QUIESCE utility is to establish a quiesce point for the same table spaces as in example 1. The list is defined in the LISTDEF utility control statement.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UD.QUIESC2',
//            UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
//DSNUPROC.SYSIN    DD  *
LISTDEF QUIESCELIST INCLUDE TABLESPACE DSN8D81A.DSN8S81D
                    INCLUDE TABLESPACE DSN8D81A.DSN8S81E
                    INCLUDE TABLESPACE DSN8D81A.DSN8S81P
QUIESCE LIST QUIESCELIST
//*
```

The following example shows the output that the preceding command produces.

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = TEMP
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  LISTDEF QUIESCELIST INCLUDE TABLESPACE DSN8D81A.DSN8S81D
INCLUDE TABLESPACE DSN8D81A.DSN8S81E
INCLUDE TABLESPACE DSN8D81A.DSN8S81P
DSNU1035I   DSNUILDR - LISTDEF STATEMENT PROCESSED SUCCESSFULLY
0DSNU050I    DSNUGUTC -  QUIESCE LIST QUIESCELIST
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81D
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81E
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81P
DSNU474I  = DSNUQUIA - QUIESCE AT RBA 000004E56419 AND AT LRSN 000004E56419
DSNU475I    DSNUQUIB - QUIESCE UTILITY COMPLETE, ELAPSED TIME= 00:00:00
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 55. Example output from a QUIESCE job that establishes a quiesce point for a list of objects

Example 3: Establishing a quiesce point for a table space set.

The following control statement specifies that QUIESCE is to establish a quiesce point for the indicated table space set. In this example, the table space set includes table space DSN8D81A.DSN8S81D and all table spaces that are referentially related to it. Run REPORT TABLESPACESET to obtain a list of table spaces that are referentially related.

```
QUIESCE TABLESPACESET TABLESPACE DSN8D11A.DSN8S11D
```

The following example shows the output that the preceding command produces.

```
DSNU000I   DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = TSLQ.STEP1
DSNU050I   DSNUGUTC - QUIESCE TABLESPACESET TABLESPACE DSN8D11A.DSN8S11D
DSNU477I - DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACESET DSN8D11A.DSN8S11D
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.DSN8S11D
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.DSN8S11E
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.PROJ
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.ACT
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.PROJACT
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.EMPPROJA
DSNU477I - DSNUQUIA -    QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D11A.DSN8S1D
DSNU474I - DSNUQUIA - QUIESCE AT RBA 000000052708 AND AT LRSN 000000052708
DSNU475I   DSNUQUIB - QUIESCE UTILITY COMPLETE, ELAPSED TIME= 00:00:25
DSNU010I   DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 56. Example output from a QUIESCE job that establishes a quiesce point for a table space set

Example 4: Establishing a quiesce point without writing the changed pages to disk

In the following example, the control statement specifies that the QUIESCE utility is to establish a quiesce point for table space DSN8D81A.DSN8S81D, without writing the changed pages to disk. (The default is to write the changed pages to disk.) In this example, a quiesce point is established for COPY YES indexes, but not for COPY NO indexes. Note that QUIESCE jobs with the WRITE YES option, which is the default, process both COPY YES indexes and COPY NO indexes. For both QUIESCE WRITE YES jobs and QUIESCE WRITE NO jobs, the utility inserts a row in SYSIBM.SYSCOPY for each COPY YES index.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UD.QUIESC2',
//            UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
//DSNUPROC.SYSIN    DD  *
QUIESCE TABLESPACE DSN8D81A.DSN8S81D WRITE NO
//*
```

The preceding command produces the output that is shown in the following example. Notice that the COPY YES index EMPNOI is placed in informational COPY-pending (ICOPY) status:

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = TEMP
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  QUIESCE TABLESPACE DSN8D81A.DSN8S81D WRITE NO
DSNU477I  = DSNUQUIA - QUIESCE SUCCESSFUL FOR TABLESPACE DSN8D81A.DSN8S81D
DSNU477I  = DSNUQUIA -    QUIESCE SUCCESSFUL FOR INDEXSPACE DSN8D81A.EMPNOI
DSNU474I  = DSNUQUIA - QUIESCE AT RBA 000004E892A3 AND AT LRSN 000004E892A3
DSNU568I  = DSNUGSRX - INDEX ADMF001.EMPNOI IS IN INFORMATIONAL COPY PENDING
DSNU475I    DSNUQUIB - QUIESCE UTILITY COMPLETE, ELAPSED TIME= 00:00:00
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 57. Example output from a QUIESCE job that establishes a quiesce point, without writing the changed pages to disk.

Example 5: Establishing a quiesce point for a list of objects

The following control statement specifies that the QUIESCE utility is to establish a quiesce point for the specified clone table space and its indexes, and write the changes to disk.

```
QUIESCE TABLESPACE DBJM0901.TPJM0901 WRITE YES CLONE
```

Chapter 26. REBUILD INDEX

The REBUILD INDEX online utility reconstructs indexes or index partitions from the table that they reference.

During the rebuild process, the REBUILD INDEX utility can also create a FlashCopy image copy of the indexes being rebuilt.

To avoid the cost of running the RUNSTATS utility afterward, you can also specify the STATISTICS option to collect inline statistics when you run the REBUILD INDEX utility.

Restriction: REBUILD INDEX SHRLEVEL CHANGE should only be used to fix a broken or restricted index, or to build an index after DEFER. You should not use the REBUILD INDEX SHRLEVEL CHANGE utility to move an index to different volumes; instead you should use the online REORG utility. REBUILD INDEX SHRLEVEL CHANGE on a unique index will not allow the INSERT option, the DELETE option, or updates that affect the unique index.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- RECOVERDB privilege for the database
- STATS privilege for the database is required if the STATISTICS keyword is specified.
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- DATAACCESS authority
- System DBADM authority
- SYSCTRL or SYSADM authority

If either the FLASHCOPY YES or FLASHCOPY CONSISTENT option is specified, the user ID that invokes the REBUILD INDEX utility must have the authority to execute the DFSMSdss COPY command.

To run REBUILD INDEX STATISTICS REPORT YES, you must use a privilege set that includes the SELECT privilege on the catalog tables.

Execution phases of REBUILD INDEX

The REBUILD INDEX utility operates in the following phases:

UTILINIT
Performs initialization and setup.

UNLOAD
Unloads index entries.

SORT Sorts unloaded index entries.

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BUILD
Builds indexes.

SORTBLD
Sorts and builds a table space for parallel index build processing.

UTILTERM
Performs cleanup.

Related tasks:

Collecting statistics by using DB2 utilities (DB2 Performance)

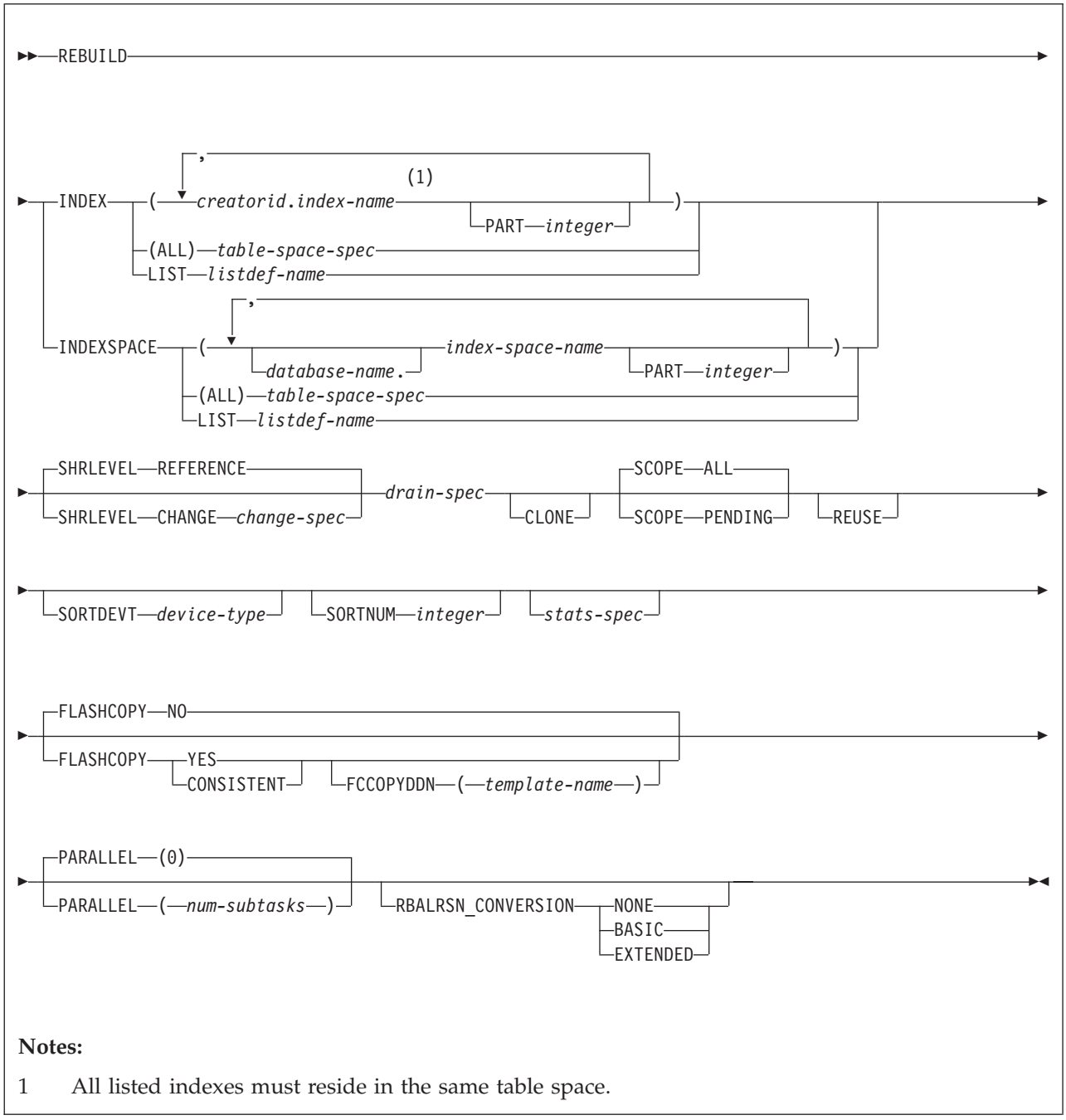
Reducing the cost of collecting statistics (DB2 Performance)

Syntax and options of the REBUILD INDEX control statement

The REBUILD INDEX utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

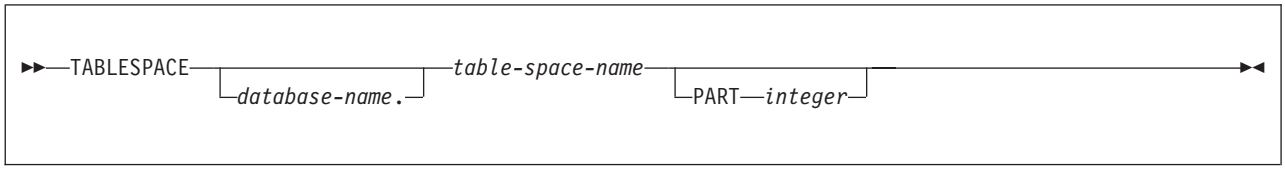
Syntax diagram



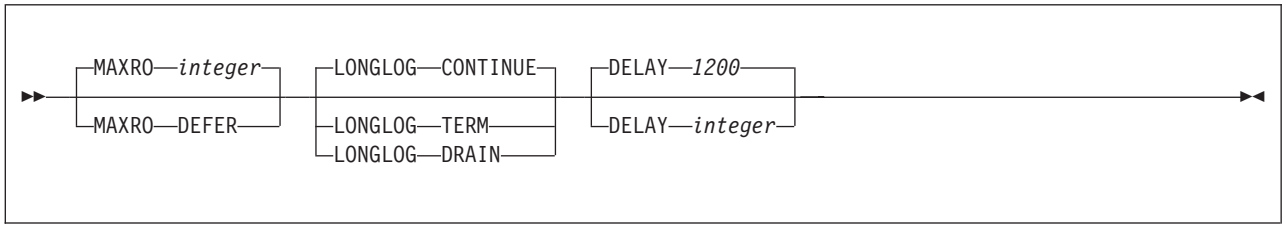
Notes:

1 All listed indexes must reside in the same table space.

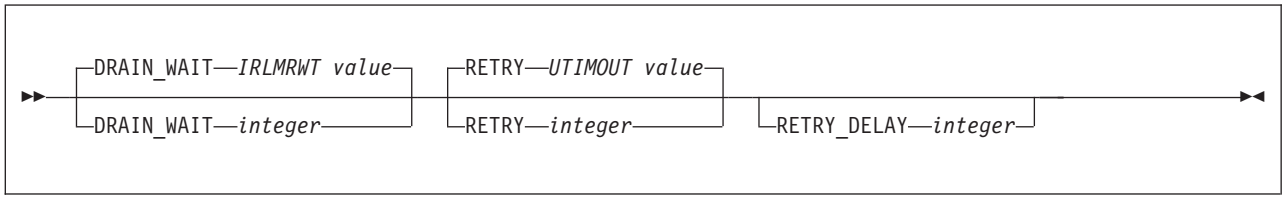
table-space-spec:



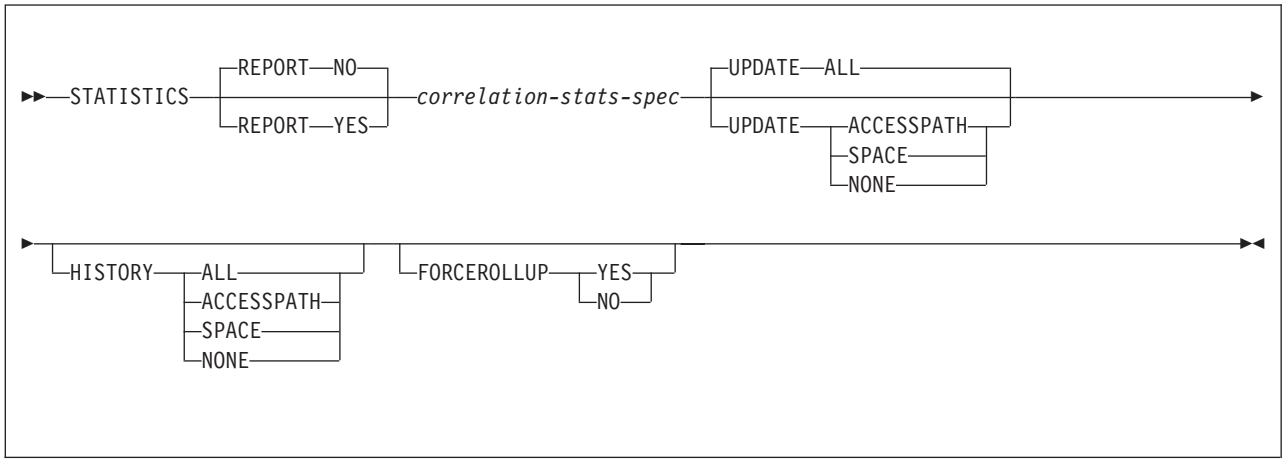
change-spec:



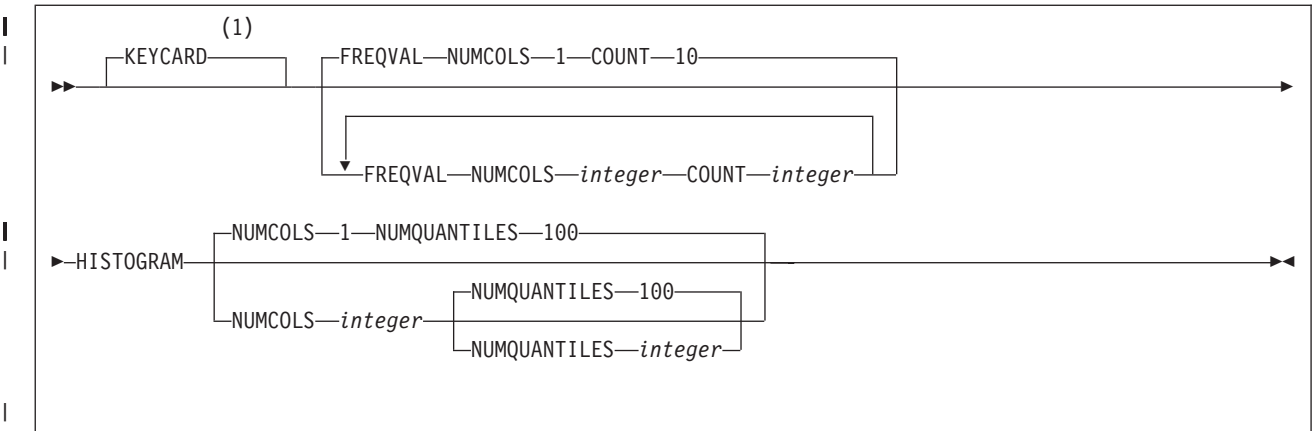
drain-spec:



stats-spec:



correlation-stats-spec:



Notes:

1 The KEYCARD option is deprecated. The functionality previously controlled by KEYCARD is incorporated into the default processing of inline statistics during the execution of REBUILD INDEX STATISTICS and cannot be disabled.

Option descriptions

INDEX *creator-id.index-name*

Indicates the qualified name of the index to be rebuilt. Use the form *creator-id.index-name* to specify the name.

creator-id

Specifies the creator of the index. This qualifier is optional. If you omit the qualifier *creator-id*, DB2 uses the user identifier for the utility job.

index-name

Specifies the qualified name of the index that is to be rebuilt. For an index, you can specify either an index name or an index space name. Enclose the index name in quotation marks if the name contains a blank.

To rebuild multiple indexes, separate each index name with a comma. All listed indexes must reside in the same table space. If more than one index is listed and the TABLESPACE keyword is not specified, DB2 locates the first valid index name that is cited and determines the table space in which that index resides. That table space is used as the target table space for all other valid index names that are listed.

INDEXSPACE *database-name.index-space-name*

Specifies the qualified name of the index space that is obtained from the SYSIBM.SYSINDEXES table.

database-name

Specifies the name of the database that is associated with the index. This qualifier is optional.

index-space-name

Specifies the qualified name of the index space to copy. For an index, you can specify either an index name or an index space name.

If you specify more than one index space, they must all be defined on the same table space.

For an index, you can specify either an index name or an index space name.

(ALL)
Specifies that all indexes in the table space that is referred to by the TABLESPACE keyword are to be rebuilt. If you specify ALL, only indexes on the base table are included.

TABLESPACE *database-name.table-space-name*
Specifies the table space from which all indexes are to be rebuilt.

database-name
Identifies the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name
Identifies the table space from which all indexes are to be rebuilt.

PART *integer*

Specifies the physical partition of a partitioning index or a data-partitioned secondary index in a partitioned table that is to be rebuilt. When the target of the REBUILD operation is a nonpartitioned secondary index, the utility reconstructs logical partitions. If any of the following situations are true for a nonpartitioned index, you cannot rebuild individual logical partitions:

- the index was created with DEFER YES
- the index must be completely rebuilt (This situation is likely in a disaster recovery scenario)
- the index is in page set REBUILD-pending (PSRBD) status

For these cases, you must rebuild the entire index.

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

You cannot specify PART with the LIST keyword. Use LISTDEF PARTLEVEL instead.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each REBUILD INDEX control statement. The list must contain either all index spaces or all table spaces. For a table space list, REBUILD is invoked once per table space. For an index space list, DB2 groups indexes by their related table space and executes the rebuild once per table space. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF utility control statement is not sufficient.

The partitions or partition ranges can be specified in a list.

SHRLEVEL
Indicates the type of access that is to be allowed for the index, table space, or partition that is to be checked during REBUILD INDEX processing.

REFERENCE
Specifies that applications can read from but cannot write to the table space or partition that REBUILD accesses. Applications cannot read or write from the index REBUILD is building.

CHANGE
Specifies that applications can read from and write to the table space or partition. The index is placed in RBDP and can be avoided by dynamic SQL. CHANGE is invalid for indexes over XML tables.

Do not specify SHRLEVEL CHANGE for an index on a NOT LOGGED table space.

Restriction:

- SHRLEVEL CHANGE is not well suited for unique indexes and concurrent DML because the index is placed in RBDP while being built. Inserts and updates of the index will fail with a resource unavailable (-904) because uniqueness checking cannot be done while the index is in RBDP.
- SHRLEVEL CHANGE is not allowed on not logged tables, XML indexes, or spatial indexes.

MAXRO

Specifies the maximum amount of time for the last iteration of log processing. During that iteration, applications have read-only access.

The actual execution time of the last iteration might exceed the specified value for MAXRO.

integer

integer is the number of seconds. Specifying a small positive value reduces the length of the period of read-only access, but it might increase the elapsed time for REBUILD INDEX to complete. If you specify a huge positive value, the second iteration of log processing is probably the last iteration.

The default value is the value of the lock timeout system parameter **IRLMRWT**.

LONGLOG

Specifies the action that DB2 is to perform, after sending a message to the console, if the number of records that the next iteration of logging is to process is not sufficiently lower than the number that the previous iterations processed. This situation means that the reading of the log by the REBUILD INDEX utility is not being done at the same time as the writing of the application log.

CONTINUE

Specifies that until the time on the JOB statement expires, DB2 is to continue performing reorganization, including iterations of log processing, if the estimated time to perform an iteration exceeds the time that is specified for MAXRO.

TERM

Specifies that DB2 is to terminate the reorganization after the delay that is specified by the DELAY parameter.

DRAIN

Specifies that DB2 is to drain the write claim class after the delay that is specified by the DELAY parameter. This action forces the final iteration of log processing to occur.

DELAY *integer*

Specifies the minimum integer between the time that REBUILD send the LONGLOG message to the console and the time that REBUILD performs the action the LONGLOG parameter specifies.

The *integer* specifies the number of seconds.

The default value is **1200**.

DRAIN_WAIT
Specifies the number of seconds that REBUILD INDEX is to wait when draining the table space or index. The specified time is the aggregate time for objects that are to be checked. This value overrides the values that are specified by the IRLMRWT and UTIMOUT subsystem parameters.

integer can be any integer from 0 to 1800. If you do not specify DRAIN_WAIT or specify a value of 0, the utility uses the value of the lock timeout subsystem parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of retries that REBUILD INDEX is to attempt.

integer can be any integer from 0 to 255. If you do not specify RETRY, REBUILD INDEX uses the value of the utility multiplier system parameter UTIMOUT.

Specifying RETRY can increase processing costs and result in multiple or extended periods during which the specified index, table space, or partition is in read-only access.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between retries. *integer* can be any integer from 1 to 1800.

If you do not specify RETRY_DELAY, REBUILD INDEX uses the DRAIN_WAIT value × RETRY value.

CLONE
Indicates that REBUILD INDEX is to reconstruct only the specified indexes that are on clone tables. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient. If you specify CLONE, you cannot specify STATISTICS. Statistics are not collected for clone objects.

SCOPE
Indicates the scope of the rebuild organization of the specified index or indexes.

ALL
Indicates that you want the specified index or indexes to be rebuilt.

PENDING
Indicates that you want the specified index or indexes with one or more partitions in REBUILD-pending (RBDP), REBUILD-pending star (RBDP*), page set REBUILD-pending (PSRBD), RECOVER-pending (RECP), or advisory REORG-pending (AREO*) state to be rebuilt.

REUSE
Specifies that REBUILD should logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE, DB2 deletes and redefines DB2-managed data sets to reset them.

If you are rebuilding the index because of a media failure, do not specify REUSE.

If a data set has multiple extents, the extents are not released if you use the REUSE parameter.

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically

allocated by the sort program. For *device-type*, you can specify any disk device that is valid on the DYNALLOC parameter of the SORT or OPTION options for the sort program.

device-type is the device type.

A TEMPLATE specification does not dynamically allocate sort work data sets. The SORTDEVT keyword controls dynamic allocation of these data sets.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated by the sort program. If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

integer is the number of temporary data sets that can range from 2 to 255.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, if there are three indexes, SORTKEYS is specified, there are no constraints limiting parallelism, and SORTNUM is specified as 8, then a total of 24 sort work data sets will be allocated for a job.

Each sort work data set consumes both above the line and below the line virtual storage, so if you specify too high a value for SORTNUM, the utility may decrease the degree of parallelism due to virtual storage constraints, and possibly decreasing the degree down to one, meaning no parallelism.

Important: The SORTNUM keyword will not be considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

STATISTICS
Specifies that index statistics are to be collected.

If you specify the STATISTICS and UPDATE options, statistics are stored in the DB2 catalog. You cannot collect inline statistics for indexes on the catalog and directory tables.

Restriction:

- If you specify STATISTICS for encrypted data, DB2 might not provide useful statistics on this data.
- You cannot specify STATISTICS for a clone index.

REPORT
Indicates whether a set of messages to report the collected statistics is to be generated.

NO Indicates that the set of messages is not to be sent as output to SYSPRINT.

YES
Indicates that the set of messages is to be sent as output to SYSPRINT. The generated messages are dependent on the combination of keywords (such as TABLESPACE, INDEX, TABLE, and COLUMN) that you specify with the RUNSTATS utility. However, these messages are not dependent on the specification of the UPDATE option. REPORT YES always generates a report of SPACE and ACCESSPATH statistics.

KEYCARD
The KEYCARD option is deprecated in the REBUILD INDEX control statement and no longer needs to be specified to collect cardinality statistics on the values in the key columns of an index.

When the STATISTICS option is specified, the REBUILD INDEX utility automatically collects all of the distinct values in all of the 1 to *n* key column combinations for the indexes being rebuilt.*n* is the number of columns in the index. With the deprecation of KEYCARD, this functionality cannot be disabled.

The REBUILD INDEX utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when STATISTICS is specified.

FREQVAL
Controls the collection of frequent-value statistics. If you specify FREQVAL, it must be followed by two additional keywords:

NUMCOLS
Indicates the number of key columns that are to be concatenated when collecting frequent values from the specified index. If you specify 3, the utility collects frequent values on the concatenation of the first three key columns.

The default value is **1**, which means that DB2 is to collect frequent values only on the first key column of the index.

COUNT
Indicates the number of frequent values that are to be collected. If you specify 15, the utility collects 15 frequent values from the specified key columns.

The default value is **10**.

HISTOGRAM
Indicates that histogram statistics are requested for the specified index.

NUMCOLS
The number of key columns that are to be concatenated when collecting histogram statistics from the specified index.

NUMQUANTILES
The integer values that follows NUMQUANTILES indicates the number quantiles are requested. The integer value must be greater than or equal to 1.

Histogram statistics can be collected only on keys with the same order. If the specified key columns for histogram statistics are of mixed or random order, a DSNU633I warning message is issued.

Histogram statistics that you collect through REBUILD INDEX are not the same as histogram statistics that you collect through RUNSTATS. Histogram statistics that you collect with REBUILD INDEX are only rough estimates. To obtain more exact statistics, use RUNSTATS.

Related information:

Histogram statistics (DB2 Performance)

DSNU633I (DB2 Messages)

UPDATE
Indicates whether the collected statistics are to be inserted into the catalog tables. UPDATE also allows you to select statistics that are used for access path selection or statistics that are used by database administrators.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that the only catalog table columns that are to be updated are those that provide statistics that are used for access path selection.

SPACE
Indicates that the only catalog table columns that are to be updated are those that provide statistics to help the database administrator assess the status of a particular table space or index.

NONE
Indicates that catalog tables are not to be updated with the collected statistics. This option is valid only when REPORT YES is specified.

HISTORY
Records all catalog table inserts or updates to the catalog history tables.

The default is supplied by the value that is specified in STATISTICS HISTORY on panel DSNTIP6.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that the only catalog history table columns that are to be updated are those that provide statistics that are used for access path selection.

SPACE
Indicates that only space-related catalog statistics are to be updated in catalog history tables.

NONE
Indicates that catalog history tables are not to be updated with the collected statistics.

FORCEROLLUP
Specifies whether aggregation or rollup of statistics is to take place when you execute RUNSTATS even if some indexes or index partitions are empty. This keyword enables the optimizer to select the best access path.

The following options are available for the **FORCEROLLUP** keyword:

YES
Indicates that forced aggregation or rollup processing is to be done, even though some indexes or index partitions might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all indexes or index partitions.

If data is not available, the utility issues DSNU623I message if you have set the installation value for STATISTICS ROLLUP on panel DSNTIP6 to NO.

FLASHCOPY
Specifies whether FlashCopy technology is used to create a copy of the object. Valid values are YES, NO, or CONSISTENT. When FlashCopy is used, a separate data set is created for each partition or piece of the object.

The FlashCopy specifications on the utility control statement override any specifications for FlashCopy that are defined by using the DB2 subsystem parameters. If the FlashCopy subsystem parameters specify the use of

FlashCopy as the default behavior of this utility, the FLASHCOPY option can be omitted from the utility control statement.

Important: If the input data set is less than one cylinder, FlashCopy technology might not be used for copying the objects regardless of the FLASHCOPY settings. The copy is performed by IDCAMS if FlashCopy is not used.

NO Specifies that no FlashCopy is made. NO is the default value for FLASHCOPY.

YES
Specifies that FlashCopy technology is used to copy the object.

Specify YES only if the DB2 data sets are on FlashCopy Version 2 disk volumes.

Important: Under the following circumstances, the REBUILD INDEX utility might not use FlashCopy even though YES is specified:

- FlashCopy Version 2 disk volumes are not available
- The source tracks are already the target of a FlashCopy operation
- The target tracks are the source of a FlashCopy operation
- The maximum number of relationships for the copy is exceeded

In the event that FlashCopy is not used, the REBUILD INDEX utility uses traditional I/O methods to copy the object, which can result in longer than expected execution time.

CONSISTENT
Specifies that FlashCopy technology is used to copy the object. Because the copies created by the REBUILD INDEX utility are already consistent, the utility treats a specification of CONSISTENT the same as a specification of YES.

PARALLEL*num-subtasks*
Specifies the maximum number of subtasks that are to be started in parallel to rebuild indexes. If the PARALLEL keyword is omitted, the maximum number of subtasks is limited by either the number of partitions being unloaded or the number of indexes built.

REBUILD INDEX typically allocates subtasks in groups of two or three, so the actual number of subtasks that are started might be less than the number specified on PARALLEL.

The specified number of subtasks for PARALLEL always overrides the specification of the PARAMDEG_UTIL subsystem parameter, so PARALLEL can be smaller or larger than the value of PARAMDEG_UTIL.

num-subtasks
Specifies the maximum number of subtasks and must be an integer between 0 and 32767, inclusive. If the specified value for *num-subtasks* is greater than 32767, the REBUILD INDEX statement fails. If 0 or no value is specified for *num-subtasks*, the REBUILD INDEX utility uses the optimal number of parallel subtasks. If the specified value for *num-subtasks* is greater than the calculated optimal number, the REBUILD INDEX utility limits the number of parallel subtasks to the optimal number with applied constraints.

RBALRSN_CONVERSION
Specifies the RBA or LRSN format of the target object after the completion of

the REBUILD INDEX utility. If the keyword is not specified, the conversion specified in the UTILITY_OBJECT_CONVERSION subsystem parameter is accepted.

NONE
Specifies that no conversion is performed.

The utility fails if RBALRSN_CONVERSION NONE is specified on a table space that is in basic 6-byte format and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

BASIC
Specifies that if an object is found in extended 10-byte format, it is converted to 6-byte basic format.

The utility fails if RBALRSN_CONVERSION BASIC is specified and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

EXTENDED
Specifies that if an object is found in basic 6-byte format, it is converted to 10-byte extended format.

If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to BASIC or EXTENDED, RBALRSN_CONVERSION defaults to the UTILITY_OBJECT_CONVERSION value. If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to NOBASIC, RBALRSN_CONVERSION defaults to EXTENDED.

If a CLONE relationship exists, the page set conversion cannot be performed. For clone relationships, you must drop the clone table, convert the base table to extended 10-byte format, and then re-create the clone table.

REBUILD of a node ID index, when converting the page format to extended, does not convert versioned XML table spaces that are associated with that base table space.

Specify RBALRSN_CONVERSION NONE during Disaster Recovery scenarios to avoid page set format conversions, which would complicate the recovery, especially when you rebuild indexes over the catalog and directory table spaces. Alternatively, set the UTILITY_OBJECT_CONVERSION subsystem parameter to NONE until the Disaster Recovery completes.

FCCOPYDDN
Specifies the template to be used to create the FlashCopy image copy data set names. If a value is not specified for FCCOPYDDN on the REBUILD INDEX control statement when FlashCopy is used, the value specified on the FCCOPYDDN subsystem parameter determines the template to be used.

(*template-name***)**
The data set names for the FlashCopy image copy are allocated according to the template specification. For table space or index space level FlashCopy image copies, because a data set is allocated for each partition or piece, ensure that the data set naming convention in the template specification is unique enough. Use the &DSNUM variable, which resolves to a partition number or piece number at execution time.

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Before running REBUILD INDEX

Certain activities might be required before you run the REBUILD INDEX utility, depending on your situation.

Because the data that DB2 needs to build an index is in the table space on which the index is based, you do not need image copies of indexes. To rebuild the index, you do not need to recover the table space, unless it is also damaged. You do not need to rebuild an index merely because you have recovered the table space on which it is based.

If you recover a table space to a prior point in time and do not recover all the indexes to the same point in time, you must rebuild all of the indexes.

Some logging might occur if both of the following conditions are true:

- The index is a nonpartitioning index.
- The index is being concurrently accessed either by SQL on a different partition of the same table space or by a utility that is run on a different partition of the same table space.

Running REBUILD INDEX when the index has a VARBINARY column.

If you run REBUILD INDEX against an index with the following characteristics, REBUILD INDEX fails:

- The index was created on a VARBINARY column or a column with a distinct type that is based on a VARBINARY data type.
- The index column has the DESC attribute.

To fix the problem, alter the column data type to BINARY, and then run REBUILD INDEX.

Data sets that REBUILD INDEX uses

The REBUILD INDEX utility uses a number of data sets during its operation.

The following table lists the data sets that REBUILD INDEX uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 62. Data sets that REBUILD INDEX uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
STPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when statistics are collected on at least one data-partitioned secondary index.	No[1]

Table 62. Data sets that REBUILD INDEX uses (continued)

Data set	Description	Required?
Work data sets	Temporary data sets for sort input and output when sorting keys. If index build parallelism is used, the DD names have the form SW*nn*WK*mm*. If index build parallelism is not used, the DD names have the form SORTWK*nn*.	Yes
Sort work data sets	Temporary data sets for sort input and output when collecting inline statistics on at least one data-partitioned secondary index. The DD names have the form ST01WK*nn*.	No[2,3,4]
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes
FlashCopy image copy data sets	For copies of the entire index space, a separate VSAM data set for each partition or piece that is contained in the index space. For partition-level or piece-level copies, a VSAM data set for each partition or piece that is being copied.	No[5]

Note:
1. STPRIN01 is required if statistics are being collected on at least one data-partitioned secondary index, but REBUILD INDEX dynamically allocates the STPRIN01 data set if UTPRINT is allocated to SYSOUT.
2. Required when collecting inline statistics on at least one data-partitioned secondary index.
3. If the DYNALLOC parm of the SORT program is not turned on, you need to allocate the data set. Otherwise, the sort program dynamically allocates the temporary data set.
4. It is recommended that you use dynamic allocation by specifying SORTDEVT in the utility statement because dynamic allocation reduces the maintenance required of the utility job JCL.
5. Required if you specify the FLASHCOPY YES

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space
Object whose indexes are to be rebuilt.

Calculating the size of the SORTWK*nn* data set

To calculate the approximate size (in bytes) of the SORTWK*nn* data set, use the following formula:

2 x (*longest index key* + *c*) x (*number of extracted keys*)

longest index key
The length of the longest index key that is to be processed by the subtask.

If the index is of varying length, the longest key is the maximum possible length of a key with all varying-length columns that are padded to their maximum length, plus 2 bytes for each varying-length column in the index. For example, if an index with 3 columns (A, B, and C) has length values of CHAR(8) for A, VARCHAR(128) for B, and VARCHAR(50) for C, the longest key is calculated as follows:

```
8 + 128 + 50 + 2 + 2 = 190
```

c A value as follows:

- 10 if the indexes that are being rebuilt are a mix of data-partitioned secondary indexes and nonpartitioned indexes
- 8 if the indexes that are being rebuilt are partitioned, or if none of them are data-partitioned secondary indexes.

number of keys
The number of keys from all indexes that the subtask sorts and processes.

Using two or three large SORTWK*nn* data sets are preferable to several small ones.

Calculating the size of the ST01WK*nn* data set

To calculate the approximate size (in bytes) of the ST01WK*nn* data set, use the following formula:

2 ×(*maximum record length* × *numcols* × (*count* + 2) × number of indexes)

The variables in the preceding formula have the following values:

maximum record length
Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

numcols
Number of key columns to concatenate when you collect frequent values from the specified index.

count Number of frequent values that DB2 is to collect.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. When you allocate sort work data sets on disk, the recommended amount of space to allow provides at least 1.2 times the amount of data that is to be sorted.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Concurrency and compatibility for REBUILD INDEX

The REBUILD INDEX utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

REBUILD INDEX SHRLEVEL CHANGE jobs cannot be run to rebuild indexes on the same table space concurrently. As an alternative, REBUILD INDEX can build

indexes in parallel by specifying multiple indexes in a single utility statement. Concurrency for rebuilding indexes in different table space is still allowed, as is the concurrency in rebuilding different partitions of an index in a partitioned table space.

Restriction: REBUILD INDEX SHRLEVEL CHANGE should only be used to fix a broken or restricted index, or to build an index after DEFER. You should not use the REBUILD INDEX SHRLEVEL CHANGE utility to move an index to different volumes; instead you should use the online REORG utility. REBUILD INDEX SHRLEVEL CHANGE on a unique index will not allow the INSERT option, the DELETE option, or updates that affect the unique index.

Claims

The following table shows which claim classes REBUILD INDEX drains and any restrictive state that the utility sets on the target object.

Table 63. Claim classes of REBUILD INDEX operations.

Target	REBUILD INDEX SHRLEVEL REFERENCE	REBUILD INDEX PART SHRLEVEL REFERENCE	REBUILD INDEX SHRLEVEL CHANGE
Table space or partition	DW/UTRO	DW/UTRO	CR/UTRW
Partitioning index, data-partitioned secondary index, or physical partition[1]	DA/UTUT	DA/UTUT	CR/UTRW
Nonpartitioned secondary index[2]	DA/UTUT	DR	CR/UTRW
Logical partition of an index[3]	N/A	DA/UTUT	CR/UTRW

Legend:
- CR - Claim the read claim class
- DA - Drain all claim classes; no concurrent SQL access
- DW - Drain the write claim class; concurrent access for SQL readers
- DR - Drains the repeatable-read claim class
- N/A - Not applicable
- UTUT - Utility restrictive state; exclusive control
- UTRO - Utility restrictive state; read-only access allowed
- UTRW - Utility restrictive state; read and write access allowed

Note:

1. Includes document ID indexes and node ID indexes over partitioned XML table spaces
2. Includes document ID indexes and node ID indexes over nonpartitioned XML table spaces and XML indexes
3. Includes logical partitions of an XML index over partitioned XML table spaces

Compatibility

The following table shows which utilities can run concurrently with REBUILD INDEX on the same target object. The target object can be an index space or a partition of an index space. If compatibility depends on particular options of a utility, that information is also shown. REBUILD INDEX does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

Table 64. Compatibility of REBUILD INDEX with other utilities

Action	REBUILD INDEX
CHECK DATA	No
CHECK INDEX	No
CHECK LOB	Yes
COPY INDEX	No
COPY TABLESPACE SHRLEVEL CHANGE	No
COPY TABLESPACE SHRLEVEL REFERENCE	Yes
DIAGNOSE	Yes
LOAD	No
MERGECOPY	Yes
MODIFY	Yes
QUIESCE	No
REBUILD INDEX	No
RECOVER INDEX	No
RECOVER TABLESPACE	No
REORG INDEX	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL with cluster index	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL without cluster index	Yes
REPAIR LOCATE by KEY	No
REPAIR LOCATE by RID DELETE or REPLACE	No
REPAIR LOCATE by RID DUMP or VERIFY	Yes
REPAIR LOCATE INDEX PAGE DUMP or VERIFY	No
REPAIR LOCATE TABLESPACE or INDEX PAGE REPLACE	No
REPAIR LOCATE TABLESPACE PAGE DUMP or VERIFY	Yes
REPORT	Yes
RUNSTATS INDEX	No
RUNSTATS TABLESPACE	Yes
STOSPACE	Yes
UNLOAD	Yes

To run REBUILD INDEX on SYSIBM.DSNLUX01 or SYSIBM.DSNLUX02, ensure that REBUILD INDEX is the only utility in the job step and the only utility that is running in the DB2 subsystem. Unloading a base table that has LOB columns is not compatible with REBUILD INDEX.

Access with REBUILD INDEX SHRLEVEL

You can specify the level of access that you have to your data when running the REBUILD INDEX utility by using the SHRLEVEL option of REBUILD INDEX.

Before target indexes are built, they are first drained (DRAIN ALL), then placed in RBDP. The indexes are shown in UTRW states.

For rebuilding an index or a partition of an index, the SHRLEVEL option lets you choose the data access level that you have during the rebuild:

Log processing with SHRLEVEL CHANGE

When you specify SHRLEVEL CHANGE, DB2 processes the log. This step executes iteratively. The first iteration processes the log records that accumulated during the previous iteration. The iterations continue until one of these conditions is met:

- DB2 estimates that the time to perform the log processing in the next iteration will be less than or equal to the time that is specified by MAXRO. If this condition is met, the next iteration is the last.
- The number of log records that the next iteration will process is not sufficiently lower than the number of log records that were processed in the previous iteration. If this condition is met but the first two conditions are not, DB2 sends message DSNU377I to the console. DB2 continues log processing for the length of time that is specified by DELAY and then performs the action specified by LONGLOG.

Operator actions

LONGLOG specifies the action that DB2 is to perform if log processing is not occurring quickly enough. If the operator does not respond to the console message DSNU377I, the LONGLOG option automatically goes into effect. You can take one of the following actions:

- Execute the TERM UTILITY command to terminate the rebuild process.

DB2 does not take the action specified in the LONGLOG phrase if any one of these events occurs before the delay expires:

- A **TERM UTILITY** command is issued.
- DB2 estimates that the time to perform the next iteration is likely to be less than or equal to the time specified on the MAXRO keyword.
- REBUILD terminates for any reason (including the deadline).

Rebuilding index partitions

The REBUILD INDEX utility can rebuild one or more partitions of a partitioned index by extracting the keys from the data rows of the table on which they are based.

When you specify the PART option, one or more partitions from a partitioning index or a data-partitioned secondary index can be rebuilt. However, for nonpartitioned indexes, you cannot rebuild individual logical partitions in certain situations.

If any of the following situations are true for a nonpartitioned index, you cannot rebuild individual logical partitions:

- the index was created with DEFER YES
- the index must be completely rebuilt (This situation is likely in a disaster recovery scenario)
- the index is in page set REBUILD-pending (PSRBD) status

For these cases, you must rebuild the entire index.

Rebuilding indexes on partition-by-growth table spaces

The REBUILD INDEX Utility might reset more partitions than it repopulates. Any excess partitions will be empty after the REBUILD process.

How to improve performance when rebuilding index partitions

You can improve the performance of the REBUILD INDEX utility by taking certain actions.

If you use the PART option to rebuild only a single partition of an index, the utility does not need to scan the entire table space.

To rebuild several indexes (including data-partitioned secondary indexes) at the same time and reduce recovery time, use parallel index rebuild, or submit multiple index jobs.

When rebuilding nonpartitioned secondary indexes and partitions of partitioned indexes, this type of parallel processing on the same table space decreases the size of the sort data set, as well as the total time that is required to sort all the keys.

When you run the REBUILD INDEX utility concurrently on separate partitions of a partitioned index (either partitioning or secondary), the sum of the processor time is approximately the time for a single REBUILD INDEX job to run against the entire index. For partitioning indexes, the elapsed time for running concurrent REBUILD INDEX jobs is a fraction of the elapsed time for running a single REBUILD INDEX job against an entire index.

When to use SHRLEVEL CHANGE:

Schedule REBUILD with SHRLEVEL CHANGE when the rate of writing is low and transactions are short. Avoid scheduling REBUILD with SHRLEVEL CHANGE when low-tolerance applications are executing.

When to use DRAIN_WAIT:

The DRAIN_WAIT option provides improved control over the time online REBUILD waits for drains. Also, because the DRAIN_WAIT is the aggregate time that online REBUILD is to wait to perform a drain on a table space and associated indexes, the length of drains is more predictable than it is when each partition and index has its own individual waiting-time limit.

By specifying a short delay time (less than the system timeout value, IRLMRWT), you can reduce the impact on applications by reducing timeouts. You can use the RETRY option to give opportunities for the online REBUILD INDEX utility to complete successfully. If you do not want to use RETRY processing, you can still use DRAIN_WAIT to set a specific and more consistent limit on the length of drains.

RETRY allows an online REBUILD that is unable to drain the objects that it requires to try again after a set period (RETRY_DELAY). Objects will remain in their original state if the drain fails in the LOG phase.

Because application SQL statements can queue behind any unsuccessful drain that the online REBUILD has tried, define a reasonable delay before you retry to allow this work to complete; the default is lock timeout subsystem parameter IRLMRWT.

When the default DRAIN WRITERS is used with SHRLEVEL CHANGE and RETRY, multiple read-only log iterations can occur. Because online REBUILD can have to do more work when RETRY is specified, multiple or extended periods of restricted access might occur. Applications that run with REBUILD must perform frequent commits. During the interval between retries, the utility is still active; consequently, other utility activity against the table space and indexes is restricted.

Recommendation: Run online REBUILD during light periods of activity on the table space or index.

Related concepts:

"Rebuilding multiple indexes"

Rebuilding multiple indexes

When you process both node ID indexes and XML indexes together, they are processed sequentially. First the node ID index is processed and then the XML index.

Building indexes in parallel

Parallel index build reduces the elapsed time for a REBUILD INDEX job by sorting the index keys and rebuilding multiple indexes or index partitions in parallel, rather than sequentially. Optimally, a pair of subtasks processes each index; one subtask sorts extracted keys, while the other subtask builds the index. REBUILD INDEX begins building each index as soon as the corresponding sort generates its first sorted record. If you specify STATISTICS, a third subtask collects the sorted keys and updates the catalog table in parallel.

The subtasks that are used for the parallel REBUILD INDEX processing use DB2 connections. If you receive message DSNU397I that indicates that the REBUILD INDEX utility is constrained, increase the number of concurrent connections by using the MAX BATCH CONNECT parameter on panel DSNTIPE.

The greatest elapsed processing-time improvements result from parallel rebuilding for:

- Multiple indexes on a table space
- A partitioning index or a data-partitioned secondary index on all partitions of a partitioned table space
- A nonpartitioned secondary index on a partitioned table space

The following figure shows the flow of a REBUILD INDEX job with a parallel index build. The same flow applies whether you rebuild a data-partitioned secondary index or a partitioning index. DB2 starts multiple subtasks to unload the entire partitioned table space. Subtasks then sort index keys and build the partitioning index in parallel. If you specify STATISTICS, additional subtasks collect the sorted keys and update the catalog table in parallel, eliminating the need for a second scan of the index by a separate RUNSTATS job.

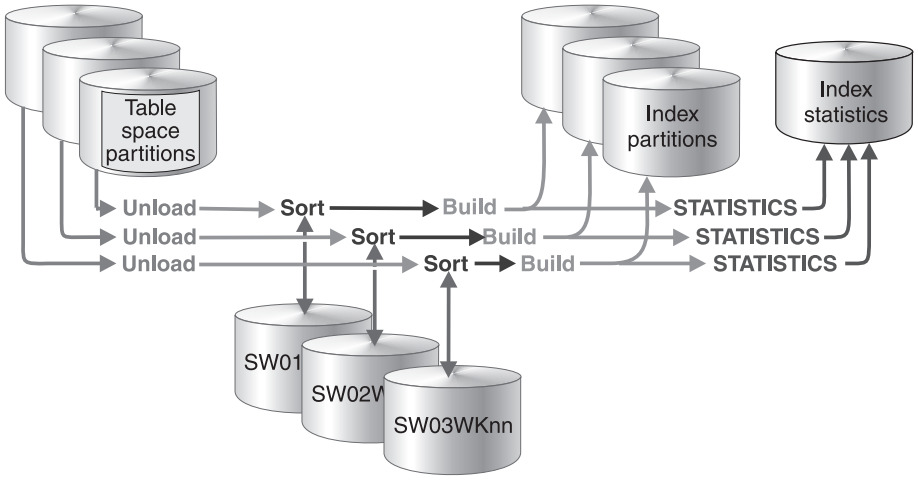


Figure 58. How a partitioning index is rebuilt during a parallel index build

The following figure shows the flow of a REBUILD INDEX job with a parallel index build. DB2 starts multiple subtasks to unload all partitions of a partitioned table space and to sort index keys in parallel. The keys are then merged and passed to the build subtask, which builds the nonpartitioned secondary index. If you specify STATISTICS, a separate subtask collects the sorted keys and updates the catalog table.

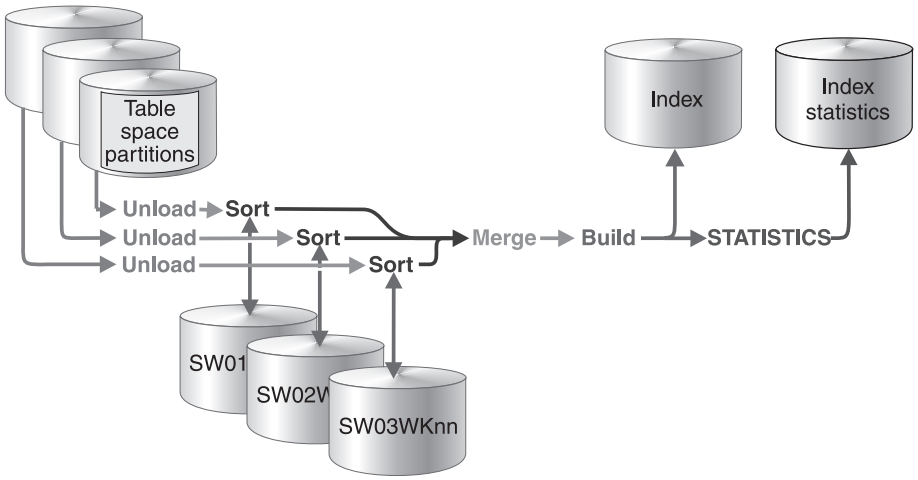


Figure 59. How a nonpartitioned secondary index is rebuilt during a parallel index build

When parallel index build is used:

REBUILD INDEX always sorts the index keys and builds them in parallel for partitioned table spaces unless constrained by available memory, sort work files, or UTPRIN*nn* file allocations.

Sort work data sets for parallel index build:

You can either allow the utility to dynamically allocate the data sets that SORT needs, or provide the necessary data sets yourself. Select one of the following methods to allocate sort work data sets and message data sets:

Method 1:

REBUILD INDEX determines the optimal number of sort work data sets and message data sets.

1. Specify the SORTDEVT keyword in the utility statement.

2. Allow dynamic allocation of sort work data sets by **not** supplying SORTWK*nn* DD statements in the REBUILD INDEX utility JCL.
3. Allocate UTPRINT to SYSOUT.

Method 2:
You control allocation of sort work data sets, and REBUILD INDEX allocates message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Allocate UTPRINT to SYSOUT.

Method 3:
You have the most control over rebuild processing; you must specify both sort work data sets and message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Provide DD statements with DD names in the form UTPRIN*nn*.

Data sets that are used

If you select Method 2 or 3, define the necessary data sets by using the following information.

Each sort subtask must have its own group of sort work data sets and its own print message data set. In addition, you need to allocate the merge message data set when you build a single nonpartitioned secondary index on a partitioned table space.

Possible reasons to allocate data sets in the utility job JCL rather than using dynamic allocation are to:
- Control the size and placement of the data sets
- Minimize device contention
- Optimally use free disk space
- Limit the number of utility subtasks that are used to build indexes

The DD names SW*nn*WK*mm* define the sort work data sets that are used during utility processing. *nn* identifies the subtask pair, and *mm* identifies one or more data sets that are to be used by that subtask pair. For example:

SW01WK01
Is the first sort work data set that is used by the subtask that builds the first index.

SW01WK02
Is the second sort work data set that is used by the subtask that builds the first index.

SW02WK01
Is the first sort work data set that is used by the subtask that builds the second index.

SW02WK02
Is the second sort work data set that is used by the subtask that builds the second index.

The DD names UTPRIN*nn* define the sort work message data sets that are used by the utility subtask pairs. *nn* identifies the subtask pair.

Every time you invoke REBUILD INDEX, new UTPRIN*nn* data sets are dynamically allocated. REBUILD INDEX does not reuse UTPRIN*nn* data sets from previous job steps. This behavior might cause the available JES2 job queue elements to be consumed more quickly than expected.

If you allocate the UTPRINT DD statement to SYSOUT in the job statement, the sort message data sets and the merge message data set, if required, are dynamically allocated. If you want the sort message data sets, merge message data sets, or both, allocated to a disk or tape data set rather than to SYSOUT, you must supply the UTPRIN*nn* or the UTMERG01 DD statements (or both) in the utility JCL. If you do not allocate the UTPRINT DD statement to SYSOUT, and you do not supply a UTMERG01 DD statement in the job statement, partitions are not unloaded in parallel.

Determining the number of sort subtasks

The maximum number of utility subtasks that are started for parallel index build equals:

- For a simple table space, segmented table space, or simple partition of a partitioned table space, the number of indexes that are to be built
- For a single index that is being built on a partitioned table space, the number of partitions that are to be unloaded

REBUILD INDEX determines the number of subtasks according to the following guidelines:

- The number of subtasks equals the number of allocated sort work data set groups.
- The number of subtasks equals the number of allocated message data sets.
- If you allocate both sort work data sets and message data set groups, the number of subtasks equals the smallest number of allocated data sets.

Allocation of sort subtasks

REBUILD INDEX attempts to assign one sort subtask for each index that is to be built. If REBUILD INDEX cannot start enough subtasks to build one index per subtask, it allocates any excess indexes across the pairs (in the order that the indexes were created), so that one or more subtasks might build more than one index.

Estimating the sort work file size

If you choose to provide the data sets, you need to know the size and number of keys that are present in all of the indexes or index partitions that are being processed by the subtask in order to calculate each sort work file size. When you determine which indexes or index partitions are assigned to which subtask pairs, use the following formula to calculate the required space.

$2 \times (\textit{maximum record length} \times \textit{numcols} \times (\textit{count} + 2) \times \text{number of indexes})$

The variables in the preceding formula have the following values:

maximum record length
: Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

numcols
Number of key columns to concatenate when you collect frequent values from the specified index.

count Number of frequent values that DB2 is to collect.

Overriding dynamic sort work data set allocation

DB2 estimates how many records are to be sorted. This information is used for dynamic allocation of sort work space. Sort work space is allocated by DB2 or by the sort program that is used.

If the table space contains rows with VARCHAR columns, DB2 might not be able to accurately estimate the number of records. If the estimated number of records is too high, if the requested sort work space is not available, or if the estimated number of records is too low, which causes the sort to overflow, the utility might fail and cause an abend.

Recommendation: To enable DB2 to calculate a more accurate estimate:

- For a table space that is partitioned (non-universal), run RUNSTATS UPDATE ALL before REORG.
- For any other type of table space, run RUNSTATS UPDATE SPACE before REORG.

When you run RUNSTATS with SHRLEVEL REFERENCE, real-time statistics values are also updated.

You can override the dynamic allocation of sort work space in one of the following ways:

- Allocate the sort work data sets with SORTWK*nn* DD statements in your JCL.
- If the number of keys for the affected index in column TOTALENTRIES of table SYSIBM.SYSINDEXSPACESTATS is not available or is significantly incorrect, you can update the value to a more appropriate value using an SQL UPDATE statement. When REBUILD INDEX on the affected index completes, TOTALENTRIES is set to the number of keys for the affected index.
- If the number of rows in the associated table space in column TOTALROWS of table SYSIBM.SYSTABLESPACESTATS is not available or is significantly incorrect, you can update the value to a more appropriate value using an SQL UPDATE statement. The next time that REORG is run, TOTALROWS is set to the number of rows in the associated table space.

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Resetting the REBUILD-pending status

REBUILD-pending status (which appears as RBDP in the output from the DISPLAY command) means that the physical or logical index partition, nonpartitioned secondary index, or logical partition of a nonpartitioned secondary index is in REBUILD-pending status.

The variations of REBUILD-pending status are as follows:

RBDP The physical or logical index partition is in the REBUILD-pending status. The individual physical or logical index partition is inaccessible. Reset the RBDP status by rebuilding the single affected partition. If multiple partitions are in RBDP status, you can rebuild either the entire index or all affected partitions.

RBDP*
The logical partition of the nonpartitioned secondary index is in the REBUILD-pending status. The entire nonpartitioned secondary index is inaccessible. Reset RBDP* status by rebuilding only the affected logical partitions.

PSRBD
The nonpartitioned secondary index space is in the REBUILD-pending status. The entire index space is inaccessible. Rebuild the object with the REBUILD INDEX utility. This state only applies to nonpartitioned secondary indexes.

You can reset the REBUILD-pending status for an index with any of these operations:
- REBUILD INDEX
- REORG TABLESPACE SORTDATA
- REPAIR SET INDEX with NORBDPEND
- START DATABASE command with ACCESS FORCE

Attention: Use the START DATABASE command with ACCESS FORCE only as a means of last resort.

Rebuilding critical catalog indexes

For information about how to rebuild critical catalog indexes, see the information about recovering catalog and directory objects.

Related tasks:

"Recovering catalog and directory objects" on page 484

Recoverability of a rebuilt index

When you successfully rebuild an index that was defined with COPY YES, utility processing inserts a SYSCOPY row with ICTYPE='B' for each rebuilt index. Rebuilt indexes are also placed in informational COPY-pending status, which indicates that you should make a copy of the index.

Recommendation: If you have FlashCopy capability, create a FlashCopy image copy during the REBUILD INDEX. Alternatively, after the index is rebuilt, make a sequential full image copy of the index to create a recovery point. Both copy methods reset the ICOPY status of the rebuilt index.

Creating a FlashCopy image copy with REBUILD INDEX

As part of REBUILD INDEX processing, you can use FlashCopy technology to quickly take image copies of the target objects.

About this task

Restriction: You cannot create FlashCopy image copies of indexes that are defined with the COPY NO attribute.

Procedure

To create a FlashCopy image copy with REBUILD INDEX:

Specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT) in the REBUILD INDEX utility control statement. Alternatively, you can set the FLASHCOPY_REBUILD_INDEX subsystem parameter to YES, which specifies that REBUILD INDEX is to use FLASHCOPY(YES) by default. The value that you specify for the FLASHCOPY option in the REBUILD INDEX statement always overrides the value for the FLASHCOPY_REBUILD_INDEX subsystem parameter. Optionally, you can also specify FCCOPYDDN in the REBUILD INDEX statement. Use this option to specify a template for the FlashCopy image copy. If you do not specify the FCCOPYDDN option in the REBUILD INDEX statement, the utility uses the value from the FCCOPYDDN subsystem parameter.

Restriction: The data sets that you specify for the FlashCopy image copy must be on FlashCopy Version 2 disk volumes.
When you specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT), REBUILD INDEX uses FlashCopy technology to create a consistent copy of the target objects. The FlashCopy image copy fails if the FlashCopy Version 2 disk volumes are not available or if any of the other FlashCopy operational restrictions exist. For a list of those operational restrictions, see "FlashCopy image copies" on page 163.

Related concepts:

"FlashCopy image copies" on page 163

Related reference:

DEFAULT TEMPLATE field (FCCOPYDDN subsystem parameter) (DB2 Installation and Migration)

REBUILD INDEX field (FLASHCOPY_REBUILD_INDEX subsystem parameter) (DB2 Installation and Migration)

Termination or restart of REBUILD INDEX

You can terminate and restart the REBUILD INDEX utility.

You can terminate REBUILD INDEX by using the TERM UTILITY command. If you terminate a REBUILD INDEX job, the index space is placed in the REBUILD-pending status and is unavailable until it is successfully rebuilt.

By default, DB2 uses RESTART(PHASE) when restarting REBUILD INDEX jobs. The job starts again from the beginning.

If you restart a job that uses the STATISTICS keyword, inline statistics collection does not occur. To update catalog statistics, run the RUNSTATS utility after the restarted REBUILD INDEX job completes.

Related tasks:

"Restarting an online utility" on page 52

The effect of REBUILD INDEX on index version numbers

DB2 stores the range of used index version numbers in the OLDEST_VERSION and CURRENT_VERSION columns of the SYSIBM.SYSINDEXES and SYSIBM.SYSINDEXPART catalog tables.

The OLDEST_VERSION column contains the oldest used version number, and the CURRENT_VERSION column contains the current version number.

When you run REBUILD INDEX, the utility updates this range of used version numbers for indexes that are defined with the COPY NO attribute. REBUILD INDEX sets the OLDEST_VERSION column to the current version number, which indicates that only one version is active; DB2 can then reuse all of the other version numbers.

Recycling of version numbers is required when all of the version numbers are being used. All version numbers are being used when one of the following situations is true:

- The value in the CURRENT_VERSION column is one less than the value in the OLDEST_VERSION column
- The value in the CURRENT_VERSION column is 15, and the value in the OLDEST_VERSION column is 0 or 1.

You can also run LOAD REPLACE, REORG INDEX, or REORG TABLESPACE to recycle version numbers for indexes that are defined with the COPY NO attribute. To recycle version numbers for indexes that are defined with the COPY YES attribute or for table spaces, run MODIFY RECOVERY.

Related concepts:

Table space versions (DB2 Administration Guide)

Sample REBUILD INDEX control statements

Use the sample control statements as models for developing your own REBUILD INDEX control statements.

Example 1: Rebuilding an index

The following control statement specifies that the REBUILD INDEX utility is to rebuild the DSN8B10.XDEPT1 index.

```
//STEP1    EXEC DSNUPROC,UID='IUIQU2UT.RBLD1',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSREC   DD DSN=IUIQU2UT.RBLD1.STEP1.SYSREC,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(8000,(20,20),,,ROUND)
//SYSIN    DD *
REBUILD INDEX (DSN8B10.XDEPT1)
/*
```

Example 2: Rebuilding index partitions

The following control statement specifies that REBUILD INDEX is to rebuild partitions 2 and 3 of the DSN8B10.XEMP1 index. The partition numbers are indicated by the PART option.

```
REBUILD INDEX (DSN8B10.XEMP1 PART 2, DSN8B10.XEMP1 PART 3)
```

Example 3: Rebuilding multiple partitions of a partitioning or secondary index

The following control statement specifies that REBUILD INDEX is to rebuild partitions 2 and 3 of the DSN8B10.XEMP1 index. The partition numbers are

indicated by the PART option. The SORTDEVT and SORTNUM keywords indicate that the utility is to use dynamic data set and message set allocation. Parallelism is used by default.

If sufficient virtual storage resources are available, DB2 starts one pair of utility sort subtasks for each partition. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing. DSNUPROC includes a DD statement that allocates UTPRINT to SYSOUT.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.RBINDEX',UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
REBUILD INDEX (DSN8B10.XEMP1 PART 2, DSN8B10.XEMP1 PART 3)
 SORTDEVT SYSWK
 SORTNUM  4
/*
```

Example 4: Rebuilding all partitions of a partitioning index

The control statement specifies that REBUILD INDEX is to rebuild all index partitions of the DSN8B10.XEMP1 partitioning index. Parallelism is used by default. For this example, REBUILD INDEX allocates sort work data sets in two groups, which limits the number of utility subtask pairs to two. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing. DSNUPROC includes a DD statement that allocates UTPRINT to SYSOUT.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.RCVINDEX',UTPROC='',SYSTEM='DSN'
//* First group of sort work data sets for parallel index rebuild
//SW01WK01 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW01WK02 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW01WK03 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//* Second group of sort work data sets for parallel index rebuild
//SW02WK01 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW02WK02 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW02WK03 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SYSIN    DD *
  REBUILD INDEX (DSN8B10.XEMP1)
/*
```

Figure 60. Example REBUILD INDEX statement

Example 5: Rebuilding all indexes of a table space

The following control statement specifies that REBUILD INDEX is to rebuild all indexes for table space DSN8D11A.DSN8S11E. The SORTDEVT and SORTNUM keywords indicate that the utility is to use dynamic data set and message set allocation. Parallelism is used by default.

If sufficient virtual storage resources are available, DB2 starts one utility sort subtask to build the partitioning index and another utility sort subtask to build the nonpartitioning index. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing. DSNUPROC includes a DD statement that allocates UTPRINT to SYSOUT.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.RCVINDEX',UTPROC='',SYSTEM='DSN'
//SYSIN    DD *
```

```
REBUILD INDEX (ALL) TABLESPACE DSN8D11A.DSN8S11E
 SORTDEVT SYSWK
 SORTNUM  4
/*
```

Example 6: Rebuilding indexes only if they are in a restrictive state and gathering inline statistics

The control statement in this example specifies that REBUILD INDEX is to rebuild partition 9 of index ID0S482D if it is in REBUILD-pending (RBDP), RECOVER-pending (RECP), or advisory REORG-pending (AREO*) state. This condition that the index be in a certain restrictive state is indicated by the SCOPE PENDING option. The STATISTICS FORCEROLLUP YES option indicates that the utility is to collect inline statistics on the index partition that it is rebuilding and to force aggregation of those statistics.

```
//STEP6    EXEC DSNUPROC,UID='JUOSU248.CHK6',
//         UTPROC='',
//         SYSTEM='SSTR'
//UTPRINT  DD  SYSOUT=*
//SYSREC   DD DSN=JUOSU248.CHKIXPX.STEP6.SYSREC,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY  DD DSN=JUOSU248.CHKIXPX.STEP6.SYSCOPY,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=JUOSU248.CHKIXPX.STEP6.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
    REBUILD INDEX (IDOS482D PART 9)
            STATISTICS FORCEROLLUP YES
            SCOPE PENDING
/*
```

Figure 61. Example REBUILD INDEX statement with STATISTICS option

Example 7: Rebuilding indexes with SHRLEVEL CHANGE.

The following control statement specifies that during the rebuild, applications can read from and write to ADMF001.IUKQAI01.

```
REBUILD INDEX (ADMF001.IUKQAI01)
         SHRLEVEL CHANGE
```

Example 8: Rebuilding indexes that are on clone tables

The following control statement specifies that REBUILD INDEX is to reconstruct only the specified indexes that are on clone tables.

```
REBUILD INDEX (ADMF001.IUKQAI01)
         CLONE
```

Chapter 27. RECOVER

The RECOVER online utility recovers data to the current state or to a previous point in time by restoring a copy and then applying log records. The online RECOVER utility can also recover data to a previous point in time by backing out committed work.

The largest unit of data recovery is the table space or index; the smallest is the page. You can recover a single object or a list of objects. The RECOVER utility recovers an entire table space, index, a partition or data set, pages within an error range, or a single page. You can recover data from sequential image copies of an object, a FlashCopy image copy of an object, a system-level backup, or the log. Point-in-time recovery with consistency automatically detects the uncommitted transactions that are running at the recover point in time and rolls back their changes on the recovered objects. So after recover, objects will be left in their transactionally consistent state.

Output

Output from RECOVER consists of recovered data (a table space, index, partition or data set, error range, or page within a table space).

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To run this utility, you must use a privilege set that includes one of the following authorities:

- RECOVERDB privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- DATAACCESS authority
- SYSCTRL or SYSADM authority

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An ID with installation SYSOPR authority can also run RECOVER, but only on a table space in the DSNDB01 or DSNDB06 database.

Restrictions on running RECOVER

- RECOVER cannot recover a table space or index that is defined to use a storage group that is defined with mixed specific and nonspecific volume IDs. If you specify such a table space or index, the job terminates and you receive error message DSNU419I.
- RECOVER cannot recover an index that was altered to PADDED or NOT PADDED. Instead, you need to rebuild the index.
- If a table space or partition in reordered row format is recovered to a point in time when the table space or partition was in basic row format, the table space or partition reverts to basic row format. Similarly, if a table space or partition in basic row format is recovered to a point in time when the table space or partition was in reordered row format, the table space or partition reverts to reordered row format.
- You cannot run RECOVER on a table space or index on which mixed specific and non-specific volume IDs were defined with CREATE STOGROUP or ALTER STOGROUP.
- You can take system-level backups with the BACKUP SYSTEM utility. However, if any of the following utilities were run since the system-level backup that was chosen as the recovery base, then the use of the system-level backup is prohibited for object level recoveries to a prior point in time:
  - REORG TABLESPACE
  - REORG INDEX
  - REBUILD INDEX
  - LOAD REPLACE
  - RECOVER from image copy or concurrent copy

  This restriction does not apply if you are using z/OS V1R11.0 or later and you set up DFSMShsm to capture catalog information.
- RECOVER cannot recover an index to a point in time if pending definition changes on that object were materialized by the REORG utility after that point in time.
- You can use RECOVER to a point in time on an index to reset the REBUILD-pending state only if the index is in the REBUILD-pending state because the associated table space was recovered to a point in time.
- RECOVER cannot recover a partition-by-growth table space to a point-in-time before REORG TABLESPACE removed empty, trailing partitions.
- Partition level recovery is required when the recovery base is an inline copy that was created by a REORG that pruned partitions.
- RECOVER cannot recover an XML table space to a point-in-time before the REORG utility that changed the format from basic to extended format.
- The following restrictions apply to recovery to a point in time that is before materialization of pending definition changes:
  - The target object must be a range-partitioned table space, a LOB table space, or an XML table space.
  - The target object must be an entire table space. You cannot recover selected partitions.
  - The table space cannot be recovered with VERIFYSET NO. If VERIFYSET NO is specified, RECOVER uses VERIFYSET YES instead.

- The RECOVER statement cannot specify TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY if the source for recovery is an image copy that was taken with the SHRLEVEL CHANGE option.
- The target table space cannot contain a clone table.

  If a clone table exists in the table space, but no data exchange occurred, you can drop the clone table, and then perform the point-in-time recovery. If data exchange occurred, you cannot perform the point-in-time recovery.
- The pending definition change cannot be:
  - A change to the table space type
  - A change to hash organization
  - DROP COLUMN
- No RECOVER jobs that recover the table space to a different point in time can run until recovery to a point-in-time before materialization of pending definition changes is complete.

  Completion of a subsequent REORG job that clears the REORG-pending (REORP) state on the table space completes the recovery.

Execution phases of RECOVER

The RECOVER utility operates in these phases:

Phase Description

UTILINIT
Performs initialization and setup.

RESTORE
Locates and merges any appropriate sequential image copies and restores the table space to a backup level; processes a list of objects in parallel if you specify the PARALLEL keyword.

RESTORER
If you specify the PARALLEL keyword, reads and merges the sequential image copies.

RESTOREW
If you specify the PARALLEL keyword, writes the pages to the object.

PRELOGC
Preliminary LOGCSR phase. Determines uncommitted work that was backed out when the recovery base for an object is a FlashCopy image copy with consistency.

PRELOGA
Preliminary LOGAPPLY phase. Applies the uncommitted work up to the point of consistency for the object with a FlashCopy image copy with consistency recovery base.

LOGAPPLY
Applies any outstanding log changes to the object that is restored from the previous phase or step. If a recover job fails in the middle of the LOGAPPLY phase, it can be restarted from last commit point.

LOGCSR
Analyzes log records and constructs information about inflight, indoubt, inabort, and postponed abort units of recovery. This phase is executed if either the TORBA and TOLOGPOINT option was specified. If a recover job fails in the middle of the LOGCSR phase, it can be restarted from the

beginning of the LOGCSR phase. DB2 members that finished the LOGCSR phase before the RECOVER job failure go through the LOGCSR phase again.

For BACKOUT YES processing, LOGCSR analyzes log records and constructs information about committed and canceled units of recovery.

LOGUNDO
Rolls back any uncommitted changes that the active units of recovery made to the recovered objects. This phase is executed if either the TORBA and TOLOGPOINT option was specified. If you need to restart the recover job after it enters into the LOGUNDO phase, objects that were not changed by URs that were active during the recover to point in time will be marked as finished and no need for further processing.

For BACKOUT YES processing, the LOGUNDO phase backs out committed changes from the current state of the object to the prior point in time specified. In addition, any uncommitted changes at the point in time specified are rolled back.

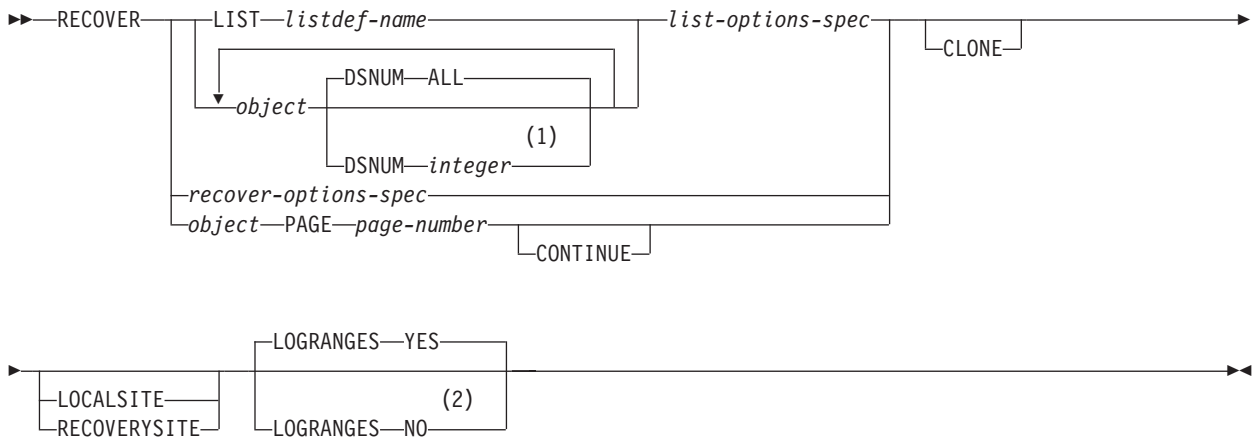
UTILTERM
Performs cleanup.

Syntax and options of the RECOVER control statement

The RECOVER utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram

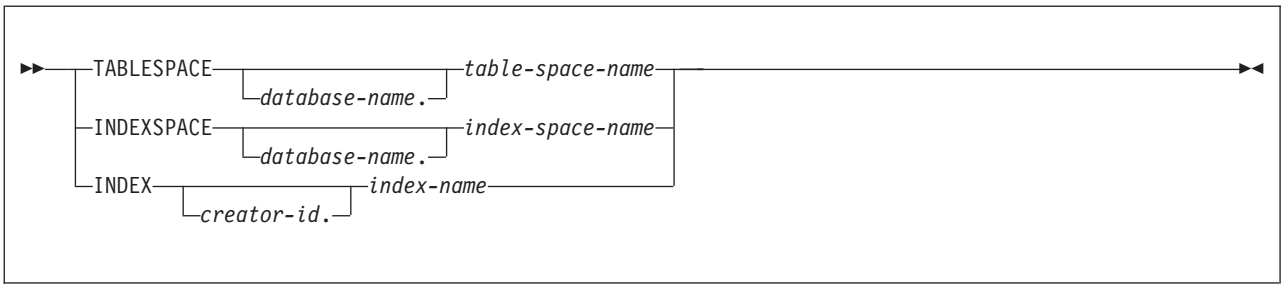


Notes:

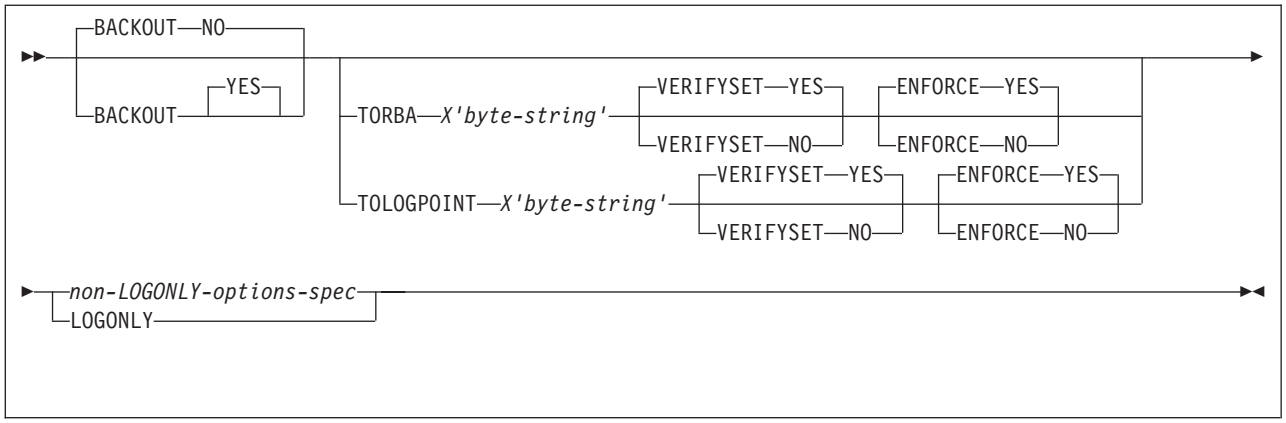
1 DSNUM *integer* is not valid for nonpartitioned indexes.

2 Use the LOGRANGES NO option only at the direction of IBM Software Support. This option can cause the LOGAPPLY phase to run much longer and, in some cases, apply log records that should not be applied.

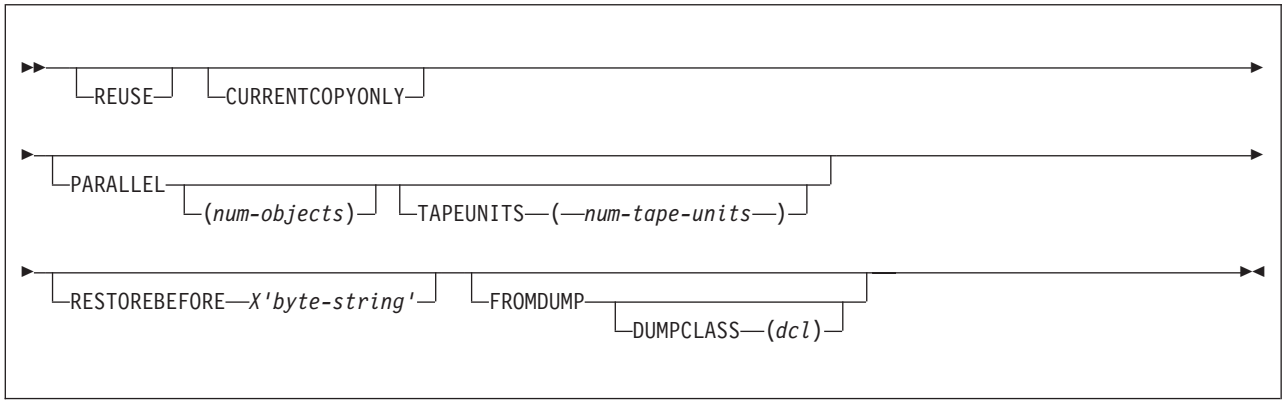
object:



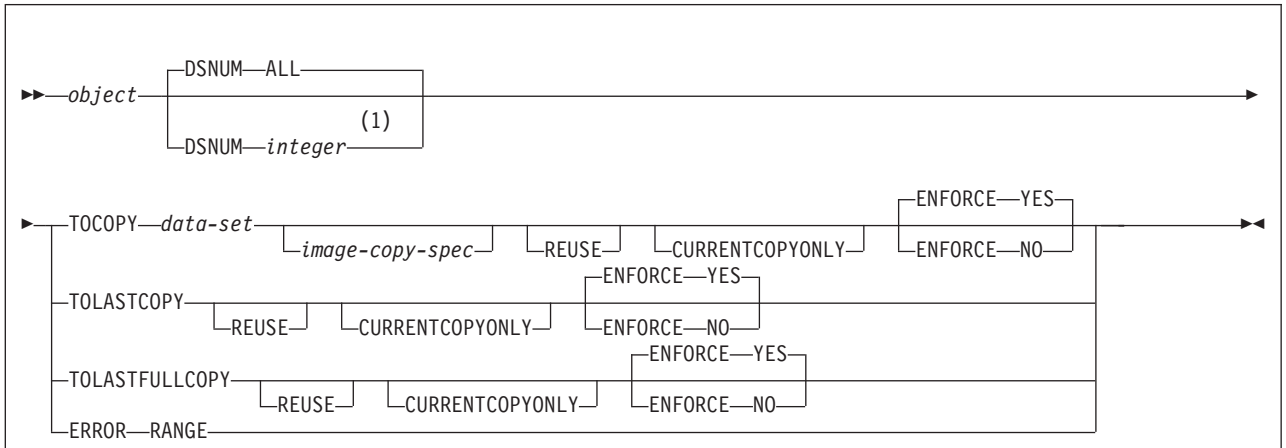
list-options-spec:



non-LOGONLY-options-spec:



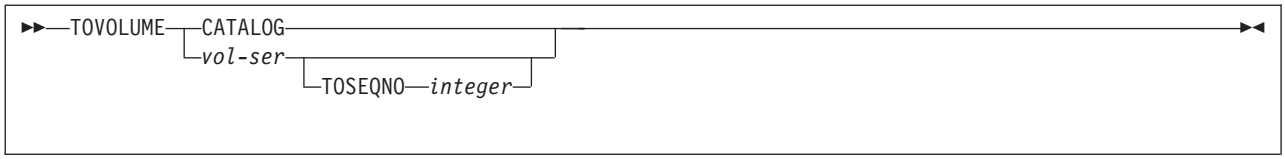
recover-options-spec:



Notes:

1 DSNUM *integer* is not valid for nonpartitioned indexes unless the data set that is specified for TOCOPY is a FlashCopy image copy.

image-copy-spec:



Option descriptions

You can specify a list of objects by repeating the TABLESPACE, INDEX, or INDEXSPACE keywords. If you use a list of objects, the valid keywords are: DSNUM, TORBA, TOLOGPOINT, LOGONLY, PARALLEL, and either LOCALSITE or RECOVERYSITE.

The options TOCOPY, TOLASTCOPY, TOLASTFULLCOPY, TORBA and TOLOGPOINT are all referred to as point-in-time recovery options.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each control statement of RECOVER. The list can contain a mixture of table spaces and index spaces. RECOVER is invoked once for the entire list.

This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

TABLESPACE *database-name.table-space-name*
Specifies the table space (and optionally, the database to which it belongs) that is to be recovered.

You can specify a list of table spaces by repeating the TABLESPACE keyword. You can recover an individual catalog or directory table space in a list with its IBM-defined indexes.

database-name
Is the name of the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name
Is the name of the table space that is to be recovered.

INDEXSPACE *database-name.index-space-name*
Specifies the index space that is to be recovered.

database-name
Specifies the name of the database to which the index space belongs.

The default value is **DSNDB04**.

index-space-name
Specifies the name of the index space that is to be recovered.

INDEX *creator-id.index-name*
Specifies the index in the index space that is to be recovered. The RECOVER utility can recover only indexes that were defined with the COPY YES attribute and subsequently copied.

creator-id
Optionally specifies the creator of the index.

The default value is the user identifier for the utility.

index-name
Specifies the name of the index in the index space that is to be recovered. Enclose the index name in quotation marks if the name contains a blank.

DSNUM
Identifies a partition within a partitioned table space or a partitioned index, or identifies a data set within a nonpartitioned table space that is to be recovered. Alternatively, the option can recover the entire table space or index space.

You cannot specify a logical partition of a nonpartitioned index. You cannot specify a single data set of a nonpartitioned index unless the data set that is specified for TOCOPY is a FlashCopy image copy. However, to ensure consistency, all data sets of a nonpartitioned index should be recovered to the same point in time.

ALL
Specifies that the entire table space or index space is to be recovered.

integer
Specifies the number of the partition or data set that is to be recovered. The maximum value is 4096.

For a partitioned table space or index space:
The integer is its physical partition number.

For a nonpartitioned table space:

Find the integer at the end of the data set name. The data set name has the following format:

catname.DSNDB*x*.*dbname*.*tsname*.*y*000*z*.A*nnn*

catname
Is the VSAM catalog name or alias.

x Is C or D.

dbname
Is the database name.

tsname Is the table space name.

y Is I or J.

z Is 1 or 2.

nnn Is the data set integer.

PAGE *page-number*
Specifies a particular page that is to be recovered. You cannot specify this option if you are recovering from a concurrent copy.

page-number is the number of the page, in either decimal or hexadecimal notation. For example, both 999 and X'3E7' represent the same page. PAGE is invalid with the LIST specification.

CONTINUE
Specifies that the recovery process is to continue. Use this option only if an error causes RECOVER to terminate during reconstruction of a page. In this case, the page is marked as "broken". After you repair the page, you can use the CONTINUE option to recover the page, starting from the point of failure in the recovery log.

Contact the IBM Support Center before you run the RECOVER utility with the PAGE CONTINUE keywords.

TORBA X'*byte-string*'
Specifies, in a non-data-sharing environment, a point on the log to which RECOVER is to recover. Specify an RBA value. The recovery process ends with the last log record whose relative byte address (RBA) is not greater than X'*byte-string*'. If X'*byte-string*' is the RBA of the first byte of a log record, that record is included in the recovery.

The RBA is a string of up to 20 hexadecimal characters, which represent the 6-byte RBA format or the extended 10-byte RBA format. Values are padded on the left with zeros if needed. Any 6-byte values are immediately converted to 10-byte format. All further RECOVER processing uses the 10-byte format.

In a data sharing environment, use TORBA only when you want to recover to a point before the originating member joined the data sharing group. If you specify an RBA after this point, the recovery fails.

For a NOT LOGGED table space, the value must be a recoverable point.

Uncommitted work by units of recovery that are active at the specified RBA are backed out by RECOVER so that each object is left in a consistent state.

TOLOGPOINT X'*byte-string*'
Specifies a point on the log to which RECOVER is to recover. Specify either an RBA or an LRSN value.

The RBA or LRSN is a string of 12 or 20 hexadecimal characters, which represent the 6-byte RBA format or the extended 10-byte RBA format. Any 10-byte values are immediately converted to 6-byte format. All further RECOVER processing is performed with the 6-byte format. In a data-sharing environment, a 6-byte LRSN value must be greater than X'00FFFFFFFFFF' and a 10-byte value must be greater than X'0000FFFFFFFFFFFFFFFF'.

For a NOT LOGGED table space, the value must be a recoverable point.

Uncommitted work by units of recovery that are active at the specified LRSN or RBA will be backed out by RECOVER, leaving each object in a consistent state.

REUSE
Specifies that RECOVER is to logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE, DB2 deletes and redefines DB2-managed data sets to reset them.

If you are recovering an object because of a media failure, do not specify REUSE.

If a data set has multiple extents, the extents are not released if you use the REUSE parameter.

CURRENTCOPYONLY
Specifies that RECOVER is to improve the performance of restoring concurrent copies (copies that were made by the COPY utility with the CONCURRENT option) by using only the most recent primary copy for each object in the list.

When you specify CURRENTCOPYONLY for a concurrent copy, RECOVER builds a DFSMSdss RESTORE command for each group of objects that is associated with a concurrent copy data set name. If the RESTORE fails, RECOVER does not automatically use the next most recent copy or the backup copy, and the object fails. If you specify DSNUM ALL with CURRENTCOPYONLY and one partition fails during the restore process, the entire utility job on that object fails.

If you specify CURRENTCOPYONLY and the most recent primary copy of the object to be recovered is not a concurrent copy, DB2 ignores this keyword.

For objects in the recovery list whose recovery base is a system-backup, the default is CURRENTCOPYONLY.

PARALLEL

Specifies the maximum number of objects in the list that are to be restored in parallel from image copies on disk or tape. RECOVER attempts to retain tape mounts for tapes that contain stacked image copies when the PARALLEL keyword is specified. In addition, to maximize performance, RECOVER determines the order in which objects are to be restored. PARALLEL also specifies the maximum number of objects in the list that are to be restored in parallel from system-level backups that have been dumped to tape. The processing may be limited by DFSMShsm.

If you specify TAPEUNITS with PARALLEL, you control the number of tape drives that are dynamically allocated for the recovery function. The TAPEUNITS keyword applies only to tape drives that are dynamically allocated. The TAPEUNITS keyword does not apply to JCL-allocated tape drives. The total number of tape drives that are allocated for the RECOVER job is the sum of the JCL-allocated tape drives, and the number of dynamically allocated tape drives. The number of dynamically allocated tape drives is determined as follows:

- The specified value for TAPEUNITS.
- The value that is determined by the RECOVER utility if you omit the TAPEUNITS keyword. The number of tape drives that RECOVER attempts to allocate is determined by the object in the list that requires the most tape drives.

If you specify PARALLEL, you cannot specify TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY.

(*num-objects***)**
Specifies the number of objects in the list that are to be processed in parallel. If storage constraints are encountered, you can adjust this value to a smaller value.

If you specify 0 or do not specify TAPEUNITS keyword, RECOVER determines the optimal number of objects to process in parallel.

TAPEUNITS
Specifies the number of tape drives that the utility should dynamically allocate for the list of objects that are to be processed in parallel. If you omit this keyword, the utility determines the number of tape drives to allocate for the recovery function.

The TAPEUNITS option does not apply to recovery from system-level backups. In this case, DFSMShsm determines the number of tape drives that are used for the recovery.

(*num-tape-units***)**
Specifies the number of tape drives to allocate. If you specify 0 or do not specify a value for *num-tape-units*, RECOVER determines the maximum number of tape units to use at one time. RECOVER TAPEUNITS has a max value of 32767.

RESTOREBEFORE *X'byte-string'*
Specifies that RECOVER is to search for an image copy, concurrent copy, or system-level backup (if yes has been specified for the

SYSTEM_LEVEL_BACKUPS subsystem parameter) with an RBA or LRSN value earlier than the specified *X'byte-string'* value to use in the RESTORE phase.

The RBA or LRSN is a string of 12 or 20 hexadecimal characters, which represent the 6-byte RBA format or the extended 10-byte RBA format. Any 10-byte values are immediately converted to 6-byte format. All further RECOVER processing is performed with the 6-byte format.In a data-sharing environment, a 6-byte LRSN value must be greater than X'00FFFFFFFFFF' and a 10-byte value must be greater than X'0000FFFFFFFFFFFFFFFF'.

To avoid specific image copies, concurrent copies, or system-level backups with matching or more recent RBA or LRSN values in START_RBA, the RECOVER utility applies the log records and restores the object to its current state or the specified TORBA or TOLOGPOINT value. The RESTOREBEFORE value is compared with the RBA or LRSN value in the START_RBA column in the SYSIBM.SYSCOPY record for those copies. For system-level backups, the RESTOREBEFORE value is compared with the data complete LRSN.

If you specify a TORBA or TOLOGPOINT value with the RESTOREBEFORE option, the RBA or LRSN value for RESTOREBEFORE must be lower than the specified TORBA OR TOLOGPOINT value. If you specify RESTOREBEFORE, you cannot specify TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY.

FROMDUMP
Specifies that only dumps of the database copy pool are used for the restore of the data sets.

DUMPCLASS *(dcl)*
Indicates the DFSMShsm dump class to use to restore the data sets.

The FROMDUMP and DUMPCLASS options that you specify for the RECOVER utility override the RESTORE/RECOVER and DUMP CLASS NAME installation options that you specify on installation panel DSNTIP6.

LOGONLY
Specifies that the target objects are to be recovered from their existing data sets by applying only log records to the data sets. DB2 applies all log records that were written after a point that is recorded in the data set itself.

To recover an index space by using RECOVER LOGONLY, you must define the index space with the COPY YES attribute.

Use the LOGONLY option when the data sets of the target objects have already been restored to a point of consistency by another process offline, such as DFSMSdss concurrent copy.

LOGONLY is not allowed on a table space or index space with the NOT LOGGED attribute.

TOCOPY *data-set*
Specifies the particular image copy data set that DB2 is to use as a source for recovery.

data-set is the name of the data set.

If the data set is a full image copy, it is the only data set that is used in the recovery. If it is an incremental image copy, RECOVER also uses the previous full image copy and any intervening incremental image copies.

If you specify the data set as the local backup copy, DB2 first tries to allocate the local primary copy. If the local primary copy is unavailable, DB2 uses the local backup copy.

If you use TOCOPY or TORBA to recover a single data set of a nonpartitioned table space, DB2 issues message DSNU520I to warn that the table space can become inconsistent following the RECOVER job. This point-in-time recovery can cause compressed data to exist without a dictionary or can even overwrite the data set that contains the current dictionary.

If you use TOCOPY with a particular partition or data set (identified with DSNUM), the image copy must be for the same partition or data set, or for the whole table space or index space. If you use TOCOPY with DSNUM ALL, the image copy must be for DSNUM ALL. You cannot specify TOCOPY with a LIST specification.If the image copy is a Flash Copy image copy data set, and the object is partitioned, you must specify the number of the partition that is to be recovered on the DSNUM parameter.

If the image copy data set is a z/OS generation data set, supply a fully qualified data set name, including the absolute generation and version number.

If the image copy data set is not a generation data set and more than one image copy data set with the same data set name exists, use one of the following options to identify the data set exactly:

TOVOLUME
Identifies the image copy data set.

CATALOG
Indicates that the data set is cataloged. Use this option only for an image copy that was created as a cataloged data set. (Its volume serial is not recorded in SYSIBM.SYSCOPY.)

RECOVER refers to the SYSIBM.SYSCOPY catalog table during execution. If you use TOVOLUME CATALOG, the data set must be cataloged. If you remove the data set from the catalog after creating it, you must catalog the data set again to make it consistent with the record for this copy that appears in SYSIBM.SYSCOPY.

vol-ser
Identifies the data set by an alphanumeric volume serial identifier of its first volume. Use this option only for an image copy that was created as a noncataloged data set. Specify the first *vol-ser* in the SYSCOPY record to locate a data set that is stored on multiple tape volumes.

TOSEQNO *integer*
Identifies the image copy data set by its file sequence number. *integer* is the file sequence number.

TOLASTCOPY
Specifies that RECOVER is to restore the object to the last image copy that was taken. If the last image copy is a full image copy, it is restored to the object. If the last image copy is an incremental image copy, the most recent full copy along with any incremental copies are restored to the object.

If the image copy is a Flash Copy image copy data set, and the object is partitioned, you must specify the number of the partition that is to be recovered on the DSNUM parameter.

TOLASTFULLCOPY
Specifies that the RECOVER utility is to restore the object to the last full image

copy that was taken. Any incremental image copies that were taken after the full image copy are not restored to the object.

If the image copy is a Flash Copy image copy data set, and the object is partitioned, you must specify the number of the partition that is to be recovered on the DSNUM parameter.

ERROR RANGE
Specifies that all pages within the range of reported I/O errors are to be recovered. Recovering an error range is useful when the range is small, relative to the object that contains it; otherwise, recovering the entire object is preferred. You cannot specify this option if you are recovering from a concurrent copy.

In some situations, recovery using the ERROR RANGE option is not possible, such as when a sufficient quantity of alternate tracks cannot be obtained for all bad records within the error range. You can use the IBM Device Support Facility, ICKDSF service utility to determine whether this situation exists. In such a situation, redefine the error data set at a different location on the volume or on a different volume, and then run the RECOVER utility without the ERROR RANGE option.

You cannot specify ERROR RANGE with a LIST specification.

VERIFYSET
Specifies whether the RECOVER utility verifies that all related objects that are required for a point-in-time recovery are included in the RECOVER control statement. This option applies to point-in-time recoveries of base objects and the following related objects:

- LOB objects
- XML objects
- History objects
- Archive objects

The VERIFYSET option does not apply to point-in-time recoveries of catalog and directory objects. VERIFYSET NO behavior is always in effect for point-in-time recoveries of catalog and directory objects.

VERIFYSET YES
The RECOVER utility verifies that all related objects that are required to perform a point-in-time recovery are included in the RECOVER control statement. VERIFYSET YES is the default.

VERIFYSET NO
The RECOVER utility does not verify that all related objects that are required to perform a point-in-time recovery are included in the RECOVER control statement.

By specifying VERIFYSET NO, you can break up a point-in-time recovery into multiple jobs or avoid recovering objects that have changed since the selected recovery point.

Related information:

Archive-enabled tables and archive tables (Introduction to DB2 for z/OS)

ENFORCE YES
Specifies that CHKP and ACHKP pending states are set for a point-in-time recovery when only a subset of the related objects (BASE, LOB, XML, and RI)

have been recovered to a point in time. ENFORCE YES is the default for catalog and directory objects. There is no override for the ENFORCE YES option for catalog and directory objects.

ENFORCE NO
Specifies that CHKP and ACHKP pending states are not set for a point-in-time recovery when only a subset of the related objects (BASE, LOB, XML, and RI) have been recovered to a point in time.

CLONE
Indicates that RECOVER is to recover only clone table data in the specified table spaces, index spaces or indexes that contain indexes on clone tables. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

LOCALSITE
Specifies that RECOVER is to use image copies from the local site. If you specify neither LOCALSITE or RECOVERYSITE, RECOVER uses image copies from the current site of invocation. (The current site is identified on the installation panel DSNTIPO under SITE TYPE and in the macro DSN6SPRM under SITETYP.)

RECOVERYSITE
Specifies that RECOVER is to use image copies from the recovery site. If you specify neither LOCALSITE or RECOVERYSITE, RECOVER uses image copies from the current site of invocation. (The current site is identified on the installation panel DSNTIPO under SITE TYPE and in the macro DSN6SPRM under SITETYP.)

LOGRANGES YES
Specifies that RECOVER should use SYSLGRNX information for the LOGAPPLY phase. This option is the default.

LOGRANGES NO
Specifies that RECOVER should not use SYSLGRNX information for the LOGAPPLY phase. Use this option only under the direction of IBM Software Support.

This option can cause RECOVER to run much longer. In a data sharing environment this option can result in the merging of all logs from all members that were created since the last image copy.

This option can also cause RECOVER to apply logs that should not be applied. For example, assume that you take an image copy of a table space and then run REORG LOG YES on the same table space. Assume also that the REORG utility abends and you then issue the TERM UTILITY command for the REORG job. The SYSLGRNX records that are associated with the REORG job are deleted, so a RECOVER job with the LOGRANGES YES option (the default) skips the log records from the REORG job. However, if you run RECOVER LOGRANGES NO, the utility applies these log records.

BACKOUT
Specifies whether a log-only backout is to be used to recover objects to a prior point in time. A log-only backout might decrease the amount of time that an object is unavailable during a point-in-time recovery if the specified recovery point is relatively recent.

NO Specifies that backout processing is not to be used.

BACKOUT NO is the default behavior.

YES

Specifies that RECOVER is to use the log to back out changes that were made since the recovery point. (The recovery point is specified by the TOLOGPOINT or TORBA options.) The changes are backed out from the current state of the object. No image copy is restored. Any uncommitted work at the specified recovery point is backed out so that the objects are transactionally consistent.

If you specify BACKOUT YES, the recovery point must be within the most recent DB2 system checkpoints that are recorded in the BSDS for each member. Otherwise, the recovery cannot proceed and returns an error.

If you specify the BACKOUT keyword without YES or NO, YES is the default. (If you do not specify the BACKOUT keyword, BACKOUT NO is the default.)

Related information:

"Point-in-time recovery" on page 494

Before running RECOVER

Certain activities might be required before you run the RECOVER utility, depending on your situation.

If the table space or index space to be recovered is associated with a storage group, DB2 deletes and redefines the necessary data sets. If the STOGROUP has been altered to remove the volume on which the table space or index space is located, RECOVER places the data set on another volume of the storage group.

If you are using Flash Copy image copies, before you start the RECOVER utility confirm that the image copies are available in disk storage. If any of the required Flash Copy image copies have been migrated to tape, issue the DFSMShsm RECALL command to restore the image copies from tape to DASD.

Recovering data and indexes

You do not always need to recover both the data and indexes. If you recover the table space or index space to a current RBA or LRSN, any referentially related objects do not need to be recovered. If you plan to recover a damaged object to a point in time, use a consistent point in time for all of its referentially related objects, including related LOB and XML table spaces, for optimal performance. You must rebuild the indexes from the data if one of the following conditions is true:

- The table space is recovered to a point in time.
- An index is damaged.
- An index is in REBUILD-pending status.
- No image copy of the index is available.

If you need to recover both the data and the indexes, and no image copies of the indexes are available:

1. Use RECOVER TABLESPACE to recover the data.
2. Run REBUILD INDEX on any related indexes to rebuild them from the data.

If you have image copies of both the table spaces and the indexes, you can recover both sets of objects in the same RECOVER utility statement. The objects are recovered from the image copies and logs.

Data sets that RECOVER uses

The RECOVER utility uses a number of data sets during its operation.

The following table lists the data sets that RECOVER uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 65. Data sets that RECOVER uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
auth-id.job-name.HSM	A temporary data set that is automatically allocated by the utility and deleted when the utility completes	Yes

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space, index space, or index
Object that is to be recovered. If you want to recover less than an entire table space:

- Use the DSNUM option to recover a partition or data set.
- Use the PAGE option to recover a single page.
- Use the ERROR RANGE option to recover a range of pages with I/O errors.

Image copy data set
Copy that RECOVER is to restore. DB2 accesses this information through the DB2 catalog.

System-level backups
The RECOVER utility chooses the most recent backup (a sequential image copy, a concurrent copy, a FlashCopy image copy, or a system-level backup) to restore based on the recovery point for the table spaces or indexes (with the COPY YES attribute) being recovered.

Related concepts:

"Before running RESTORE SYSTEM" on page 730

"How the RECOVER utility retains tape mounts" on page 507

"Data sets that online utilities use" on page 18

Related tasks:

"Recovering with a system-level backup" on page 474

Concurrency and compatibility for RECOVER

The RECOVER utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible. However, if a nonpartitioned secondary index exists on a partitioned table space, utilities that operate on different partitions of a table space can be incompatible because of contention on the nonpartitioned secondary index.

The following table shows which claim classes RECOVER claims and drains and any restrictive state that the utility sets on the target object.

Claims

Table 66. Claim classes of RECOVER operations.

Target	RECOVER (no option)	RECOVER TORBA or TOCOPY	RECOVER PART TORBA or TOCOPY	RECOVER ERROR-RANGE
Table space or partition	DA/UTUT	DA/UTUT	DA/UTUT	DA/UTUT CW/UTRW[1]
Partitioning index, data-partitioned secondary index, or physical partition[2]	DA/UTUT	DA/UTUT	DA/UTUT	DA/UTUT CW/UTRW[1]
Nonpartitioned secondary index[3]	DA/UTUT	DA/UTUT	DA/UTUT	DA/UTUT CW/UTRW[1]
RI dependents	none	CHKP (YES)	CHKP (YES)	none

Legend:
- CHKP (YES): Concurrently running applications enter CHECK-pending after commit
- CW: Claim the write claim class
- DA: Drain all claim classes, no concurrent SQL access
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers
- RI: Referential integrity
- UTRW: Utility restrictive state, read-write access allowed
- UTUT: Utility restrictive state, exclusive control
- none: Object is not affected by this utility

Note:

1. During the UTILINIT phase, the claim and restrictive states change from DA/UTUT to CW/UTRW.
2. Includes document ID indexes and node ID indexes over nonpartitioned XML table spaces and XML indexes.
3. Includes document ID indexes and node ID indexes over partitioned XML table spaces.

RECOVER does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

Compatibility

The following table shows which utilities can run concurrently with RECOVER on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also documented in the table.

Table 67. Compatibility of RECOVER with other utilities

Action	Compatible with RECOVER (no option)?	Compatible with RECOVER TOCOPY or TORBA?	Compatible with RECOVER ERROR-RANGE?
CHECK DATA	No	No	No
CHECK INDEX	No	No	No
CHECK LOB	No	No	No
COPY INDEXSPACE	No	No	No

Table 67. Compatibility of RECOVER with other utilities (continued)

Action	Compatible with RECOVER (no option)?	Compatible with RECOVER TOCOPY or TORBA?	Compatible with RECOVER ERROR-RANGE?
COPY TABLESPACE	No	No	No
DIAGNOSE	Yes	Yes	Yes
LOAD	No	No	No
MERGECOPY	No	No	No
MODIFY	No	No	No
QUIESCE	No	No	No
REBUILD INDEX	No	No	No
REORG INDEX	Yes	No	Yes
REORG TABLESPACE	No	No	No
REPAIR LOCATE INDEX	Yes	No	Yes
REPAIR LOCATE TABLESPACE	No	No	No
REPORT	Yes	Yes	Yes
RUNSTATS INDEX	No	No	No
RUNSTATS TABLESPACE	No	No	No
STOSPACE	Yes	Yes	Yes
UNLOAD	No	No	No

To run on DSNDB01.SYSUTILX, RECOVER must be the only utility in the job step and the only utility running in the DB2 subsystem.

RECOVER on any catalog or directory table space is an exclusive job; such a job can interrupt another job between job steps, possibly causing the interrupted job to time out.

Recovering with a system-level backup

You can take system-level backups by using the BACKUP SYSTEM utility. In some cases, the RECOVER utility can use a system-level backup of the database copy pool as a recovery base.

Before you begin

Recovery of objects from system-level backups requires z/OS Version 1.8 or later.

Procedure

To specify that system-level backups can be used by RECOVER:

Specify YES for the SYSTEM_LEVEL_BACKUPS installation option on installation panel DSNTIP6.
The RECOVER utility chooses the most recent backup to restore. The backup can be:

- A sequential format image copy
- A VSAM FlashCopy® image copy

- A concurrent copy
- A system-level backup

The choice of which backup is to be restored is based on the recovery point for the table spaces or indexes that are being recovered. (For an index to be recovered in this way, the COPY YES attribute must be specified.) However, several exceptions for using a system-level backup exist.

Exceptions:

If any of the following utilities were run since the system-level backup that was chosen as the recovery base, the use of the system-level backup by the RECOVER utility is prohibited:

- REORG TABLESPACE
- REORG INDEX
- REBUILD INDEX
- LOAD REPLACE
- RECOVER from image copy or concurrent copy

In these cases, the recovery terminates with message DSNU1528I and return code 8.

Note: For z/OS Version 1 Release 11 and later, the RECOVER utility can use a system-level backup, even if the REBUILD INDEX, RECOVER, REORG, and LOAD utilities ran after the system-level backup was created. The RECOVER utility has been modified so that you can use system-level backups, even if a data set has moved since the backup was created.

If a REORG that removes dropped columns has run since the system-level backup that was chosen as the recovery base, the use of the system-level backup by the RECOVER utility is prohibited, and the recovery terminates with message DSNU556I and return code 8.

For a partition-by-growth table space, a point-in-time recovery is not allowed if the recovery period includes REORG TABLESPACE deleting empty partitions. REORG TABLESPACE can delete the highest numbered partitions if they are empty and the REORG_DROP_PBG_PARTS subsystem parameter is set to ENABLE.

The RECOVER utility invokes DFSMShsm to restore the data sets for the object from the system-level backup of the database copy pool. The user ID that invokes the RECOVER utility must have the authority to execute the DFSMShsm FRRECOV command.

Related reference:

FRRECOV command: Requesting a fast replication recovery (z/OS DFSMShsm Storage Administration Reference)

How to determine which system-level backups DB2 recovers

DB2 recovers different system level backups, depending on your situation.

To determine which system-level backups will be recovered:

- If you specify YES in the RESTORE/RECOVER FROM DUMP field on installation panel DSNTIP6 or you specify the FROMDUMP option in the RECOVER utility statement, DB2 uses only the dumps on tape of the database copy pool.
- If you specify a dump class name in the DUMP CLASS NAME field on installation panel DSNTIP6 or you specify the DUMPCLASS option in the RECOVER utility statement, DB2 uses dumps on tape of the database copy pool to restore the data sets from the DFSMshsm dump class.

- If you do not specify a dump class name in the DUMP CLASS NAME field on installation panel DSNTIP6, or you do not specify the DUMPCLASS option in the RECOVER utility statement, RESTORE SYSTEM issues the DFSMShsm LIST COPYPOOL command and uses the first dump class listed in the output.

If FROMDUMP was not specified on the RECOVER utility statement or on installation panel DSNTIP6, the system-level backup on disk is used. If the system-level backup does not reside on disk, an error message is issued. If FROMDUMP was specified either on the RECOVER utility statement or on installation panel DSNTIP6, then the dumped copy of the system-level backup on tape is used.

Determining which recovery base DB2 uses

The recovery base is the copy that the RECOVER utility starts with when recovering an object. RECOVER then applies logs as needed.

Procedure

To determine which recovery base DB2 uses:

Run the REPORT utility with the RECOVERY option. Review the output to determine whether the objects to be recovered have any of the following items:

- Sequential image copies
- Concurrent copies
- FlashCopy image copies
- a utility LOG YES event

If you take system-level backups and the value of the SYSTEM_LEVEL_BACKUPS subsystem parameter is YES, also look at your system-level backup information in the BSDS to determine the recovery base.

Related concepts:

"REPORT output" on page 700

"How to determine which system-level backups DB2 recovers" on page 475

Related reference:

SYSTEM-LEVEL BACKUPS field (SYSTEM_LEVEL_BACKUPS subsystem parameter) (DB2 Installation and Migration)

Determining whether the system-level backups reside on disk or tape

Restoring data sets for objects in the database copy pool that are to be recovered from a system-level backup on disk occurs virtually instantaneously. Restoring data sets for objects that are to be recovered from a system-level backup on tape volumes takes much longer.

Procedure

To determine whether the system-level backups of the database copy pool reside on the disk or tape:

1. Run the DFSMShsm LIST COPYPOOL command with the ALLVOLS option.
2. Run the DSNJU004 utility output. For data sharing, run the DSNJU004 utility output on each member.

3. Review the output from the DFSMShsm LIST COPYPOOL command with the ALLVOLS option.
4. Review the DB2 system-level backup information in the DSNJU004 utility output.

Results

If the system-level backup that was chosen as the recovery base for the database copy pool no longer resides on DASD and the FROMDUMP option has not been specified, the recovery of the object will fail. You can specify the RECOVER FROMDUMP option, or specify it on installation panel DSNTIP6, to direct the utility to use the system-level backup that was dumped to tape. You can also use the RECOVER RESTOREBEFORE option to direct the utility to use a recovery base prior to the system-level backup.

Related reference:

Chapter 42, “DSNJU004 (print log map),” on page 923

Recovering a table space

Each table space that is involved is unavailable for most other applications until recovery is complete. If you make image copies by table space, you can recover the entire table space, or you can recover a data set or partition from the table space. If you make image copies separately by partition or data set, you must recover the partitions or data sets by running separate RECOVER operations.

The following RECOVER statement specifies that the utility is to recover table space DSN8S11D in database DSN8D11A:

```
RECOVER TABLESPACE DSN8D11A.DSN8S11D
```

To recover multiple table spaces, create a list of table spaces that are to be recovered; repeat the TABLESPACE keyword before each specified table space. The following RECOVER statement specifies that the utility is to recover partition 2 of the partitioned table space DSN8D11A.DSN8S11E, and recover the table space DSN8D11A.DSN8S11D to the quiesce point (RBA X'000007425468').

```
RECOVER TABLESPACE DSN8D11A.DSN8S11E DSNUM 2
        TABLESPACE DSN8D11A.DSN8S11D
        TORBA X'000007425468'
```

The following example shows the RECOVER statement for recovering four data sets in database DSN8D11A, table space DSN8S11E:

```
RECOVER PARALLEL (4)
    TABLESPACE DSN8D11A.DSN8S11E DSNUM 1
        TABLESPACE DSN8D11A.DSN8S11E DSNUM 2
        TABLESPACE DSN8D11A.DSN8S11E DSNUM 3
        TABLESPACE DSN8D11A.DSN8S11E DSNUM 4
```

Each of the 4 partitions will be restored in parallel. You can also schedule the recovery of these data sets to run in four separate jobs.

If a table space or data set is in the COPY-pending status, recovering it might not be possible.

Related concepts:

“Resetting COPY-pending status” on page 353

Recovering a list of objects

You can recover table spaces, table space partitions, pieces of a nonpartitioned table space, index spaces, index space partitions, and indexes.

When you recover an object to a prior point in time, you should recover a set of referentially related table spaces together to avoid putting any of the table spaces in CHECK-pending status. Use REPORT TABLESPACESET to obtain a table space listing.

Objects that are to be restored from a system-level backup are restored by the main task for the RECOVER utility by invoking DFSMShsm. Objects that are to be restored from a FlashCopy image copy are restored by invoking DFSMShsm.

Each object can have a different base from which to recover: system-level backup, image copy, concurrent copy, or FlashCopy image copy.

RECOVER does not place dependent table spaces that are related by informational referential constraints into CHECK-pending status.

The RECOVER utility merges incremental copies serially and dynamically. As a result, recovery of a table space list with numerous incremental copies can be time-consuming and operator-intensive.

If referential integrity violations are not an issue, you can run a separate job to recover each table space.

When you specify the PARALLEL keyword, DB2 supports parallelism during the RESTORE phase and performs recovery as follows:

- During initialization and setup (the UTILINIT recover phase), the utility locates the full and incremental copy information for each object in the list from SYSIBM.SYSCOPY.
- The utility sorts the list of objects for recovery into lists to be processed in parallel according to the number of tape volumes, file sequence numbers, and sizes of each image copy.
- The number of objects that can be restored in parallel depends on the maximum number of available tape devices and on how many tape devices the utility requires for the incremental and full image copy data sets. You can control the number of objects that are to be processed in parallel on the PARALLEL keyword. You can control the number of dynamically allocated tape drives on the TAPEUNITS keyword, which is specified with the PARALLEL keyword.
- If an object in the list requires a DB2 concurrent copy, the utility sorts the object in its own list and processes the list in the main task, while the objects in the other sorted lists are restored in parallel. If the concurrent copies that are to be restored are on tape volumes, the utility uses one tape device and counts it toward the maximum value that is specified for TAPEUNITS.
- If objects in the list require a system-level backup that was dumped to tape as its recovery base (that is, the FROMDUMP option was specified), the RECOVER utility will invoke DFSMShsm to restore the data sets for the objects in parallel. In this case, the degree of parallelism cannot exceed the maximum number of tasks that can be started by the RECOVER utility. DFSMShsm restores the data sets in parallel based on its installation options.

Recovering a data set or partition

You can use the RECOVER utility to recover individual partitions and data sets. The phases for data set recovery are the same as for table space recovery.

About this task

If image copies are taken at the data set level, RECOVER must be run at the data set level.

If you took FlashCopy image copies at the table space level (by specifying the DSNUM ALL option in the COPY statement), you do not have to recover all of the data sets individually. Even though SYSIBM.SYSCOPY contains records for each partition or piece of the FlashCopy image copy data set, you can recover the entire table space as one object in the RECOVER statement. This recovery is possible, because SYSIBM.SYSCOPY also contains a record to indicate that the FlashCopy image copy was taken at the table space level. Alternatively, you can recover each of the data sets individually.

Restriction: RECOVER does not support recovery of the following data sets and partitions:

- A single data set for nonpartitioned secondary indexes
- A logical partition of a nonpartitioned secondary index

Procedure

To recover a data set or partition, take one of the following actions:

- If image copies are taken at the data set level and you want to recover the whole table space, recover all of the data sets individually in one or more RECOVER steps. If recovery is attempted at the table space level, DB2 returns an error message.
- If image copies are taken at the table space, index, or index space level, recover individual data sets by using the DSNUM parameter in the RECOVER statement.

Recovering with incremental copies

The RECOVER utility merges all incremental image copies that were taken since the last full image copy.

The utility must have all the image copies available at the same time. If this requirement is likely to strain your system resources, for example, by demanding more tape units than are available, consider running MERGECOPY regularly to merge image copies into one copy.

Even if you do not periodically merge multiple image copies into one copy when you do not have enough tape units, the utility can still perform. RECOVER dynamically allocates the full image copy and attempts to dynamically allocate all the incremental image copy data sets. If RECOVER successfully allocates every incremental copy, recovery proceeds to merge pages to table spaces and apply the log. If a point is reached where an incremental copy cannot be allocated, RECOVER notes the log RBA or LRSN of the last successfully allocated data set. Attempts to allocate incremental copies cease, and the merge proceeds using only the allocated data sets. The log is applied from the noted RBA or LRSN, and the incremental image copies that were not allocated are ignored.

Recovering with FlashCopy image copies

Recovering from a FlashCopy image copy is potentially faster than recovering from a traditional image copy. If an appropriate FlashCopy image copy is available, the RECOVER utility can use it to instantaneously restore an image copy.

About this task

Consider the following information when planning for recovery with FlashCopy image copies:

- Create both FlashCopy image copies and traditional sequential image copies to provide a complete recovery base for media failures.
- Creating and recovering from a consistent FlashCopy image copy can consume more processing resources than creating and recovering from a FlashCopy image copy that was not guaranteed to be consistent. To recover from a consistent FlashCopy image copy, the RECOVER utility must read the logs to apply changes that were made to the recovered object after the point of consistency. Some of those changes are likely to be work that was previously backed out and must be reapplied, because the work was uncommitted at the time the FlashCopy image copy was created. (In this case, recovery requires more analysis of the logs during the PRELOGC phase. The preliminary log apply phase, PRELOGA, and the other log phases also require more analysis.) The START_RBA value in the SYSCOPY record of the FlashCopy image copy indicates the low RBA or LRSN of the logs that are needed for processing by RECOVER.
- Recovering with FlashCopy image copies could prevent a subsequent BACKUP SYSTEM utility job on the same data from completing successfully if the FlashCopy relationship is still outstanding.

  This limitation exists because of the characteristics of FlashCopy relationships. When the RECOVER utility uses fast replication to restore a FlashCopy image copy, it establishes a FlashCopy relationship. This relationship is between the FlashCopy image copy data set (the FlashCopy source) and the underlying data sets for the table space or index space (the FlashCopy target). Cascading FlashCopy relationships, where a data set or extent is both a FlashCopy target and a source, is not supported by the hardware.

  BACKUP SYSTEM also uses FlashCopy technology. Therefore, any of the FlashCopy targets from the RECOVER operation (those underlying data sets for the table space or index space) cannot also be used as a source for BACKUP SYSTEM while the FlashCopy relationship from RECOVER still exists.

  If you plan to use BACKUP SYSTEM, use the REC_FASTREPLICATION subsystem parameter as described in step 1 to control whether the RECOVER utility should use FlashCopy to restore FlashCopy image copies.
- If the FlashCopy image copy has been migrated or deleted, RECOVER uses the equivalent sequential image copies (created from the FlashCopy image copy) if any exist. Otherwise, the next most recent eligible recovery base is used.

Procedure

To recover with FlashCopy image copies:

1. Ensure that the REC_FASTREPLICATION subsystem parameter is set to PREFERRED or REQUIRED.

   If this subsystem parameter is set to PREFERRED, RECOVER attempts to use fast replication (FlashCopy) to restore the FlashCopy image copy. Fast replication is not used if the underlying data sets for the table space or index

space are already in a FlashCopy relationship due to the BACKUP SYSTEM utility or to the COPY utility. In this case, traditional I/O methods are used instead of fast replication to restore the FlashCopy image copy.

If this subsystem parameter is set to REQUIRED, RECOVER must use fast replication to restore the FlashCopy image copy. If fast replication cannot be used, the recovery of the object fails. For example, the recovery could fail if the BACKUP SYSTEM utility has established a FlashCopy relationship with the production volume.

Restriction: If the RECOVER utility establishes a FlashCopy relationship to restore a FlashCopy image copy and the BACKUP SYSTEM utility is started, the creation of the system-level backup might fail. The reason for the failure is because cascading FlashCopy relationships are not supported.

Otherwise, if this subsystem parameter is set to NONE, RECOVER restores the FlashCopy image copy using traditional I/O methods. Use this option if you use BACKUP SYSTEM and you do not want recovery from FlashCopy image copies to interfere with the creation of system-level backups.

2. Specify an appropriate RECOVER utility control statement. You do not need to specify any extra options in the RECOVER statement to indicate that you want FlashCopy image copies to be used. The RECOVER utility uses FlashCopy image copies if available.

   However, if you specify that RECOVER is to use a specific FlashCopy image copy (by specifying TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY), specify the DSNUM option with the appropriate data set or partition number for the FlashCopy image copy that you want to use.

   If you took FlashCopy image copies at the table space level (by specifying the DSNUM ALL option in the COPY statement), you do not have to recover all of the data sets individually. You can recover the entire table space as one object in the RECOVER statement. Alternatively, you can recover each of the data sets individually.

Related concepts:

"FlashCopy image copies" on page 163

"Subsystem parameters for refining DFSMSdss COPY operation with utilities" on page 48

Related reference:

FAST RESTORE field (REC_FASTREPLICATION subsystem parameter) (DB2 Installation and Migration)

Recovering a page

Using RECOVER PAGE enables you to recover data on a page that is damaged.

In some situations, you can determine (usually from an error message) which page of an object has been damaged. You can use the PAGE option to recover a single page. You can use the CONTINUE option to continue recovering a page that was damaged during the LOGAPPLY phase of a RECOVER operation.

Suppose that you start RECOVER for table space TSPACE1. During processing, message DSNI012I informs you of a problem that damages page number 5. RECOVER completes, but the damaged page, number 5, is in a stopped state and is not recovered. When RECOVER ends, message DSNU501I informs you that page 5 is damaged.

To repair the damaged page:

1. Use the DUMP option of the REPAIR utility to view the contents of the damaged page. Determine what change should have been made by the applicable log record, and apply it by using the REPLACE option of REPAIR. Use the RESET option to turn off the inconsistent-data indicator.

   Attention: Be extremely careful when using the REPAIR utility to replace data. Using REPAIR to change data to invalid values can produce unpredictable results, particularly when you change page header information. Improper use of REPAIR can result in damaged data, or in some cases, system failure.
2. Resubmit the RECOVER utility job by specifying TABLESPACE(TSPACE1) PAGE(*5*) CONTINUE. The RECOVER utility finishes recovering the damaged page by applying the log records that remain after the one that caused the problem.

If more than one page is damaged during RECOVER, perform the preceding steps for each damaged page.

Recovering an error range

By using the ERROR RANGE option of RECOVER, you can repair pages with reported I/O errors. DB2 maintains a page error range for I/O errors for each data set; pages within the range cannot be accessed. The DISPLAY DATABASE command displays the range.

When recovering an error range, RECOVER:
1. Locates, allocates, and applies image copies.
2. Applies changes from the log.

The following RECOVER statement specifies that the utility is to recover any current error range problems for table space TS1:

```
RECOVER TABLESPACE DB1.TS1 ERROR RANGE
```

Recovering an error range is useful when the range is small, relative to the object containing it; otherwise, recovering the entire object is preferable.

Message DSNU086I indicates that I/O errors were detected on a table space and that you need to recover it. Before you attempt to use the ERROR RANGE option of RECOVER, you should run the ICKDSF service utility to correct the disk error. If an I/O error is detected during RECOVER processing, DB2 issues message DSNU538I to identify the affected target tracks are involved. The message provides enough information to run ICKDSF correctly.

In some situations, which are announced by error messages, recovery of only an error range is not possible. In such a situation, recovering the entire object is preferable.

During the recovery of the entire table space or index space, DB2 might still encounter I/O errors that indicate DB2 is still using a bad volume. For user-defined data sets, you should use Access Method Services to delete the data sets and redefine them with the same name on a new volume. If you use DB2 storage groups, you can remove the bad volume from the storage group by using ALTER STOGROUP. If you use DFSMS storage groups, you should also remove the bad volume from the DFSMS storage group.

Effect on RECOVER of the NOT LOGGED or LOGGED table space attributes

You can recover NOT LOGGED table spaces to any recoverable point.

Recoverable points are established when you take one of the following actions:

- Alter a table space from LOGGED to NOT LOGGED. If a base table space is altered to NOT LOGGED and its associated LOB table spaces already have the NOT LOGGED attribute, the ALTER to NOT LOGGED is not a recoverable point.
- Take an image copy from a NOT LOGGED table space.
- When a table has the NOT LOGGED attribute, and an ALTER TABLE with the ADD PARTITION clause is executed.
- When insertion of data into a partition-by-growth table space causes DB2 to add a new partition.

To recover a set of objects with LOB relationships, you should run RECOVER with the TOLOGPOINT option to identify a common recoverable point for all objects. For a non-LOB table space, or a LOB table space with a base table space that has the NOT LOGGED attribute, the logging attribute of the table space must meet these following conditions:

- For recovery to the current point in time, the current value of the logging attribute of the object must match the logging attribute at the most current recoverable point.
- For recovery to a prior point in time, the current value of the logging attribute of the object must match the logging attribute at the time that is specified by TOLOGPOINT, TORBA, TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY

Recovering with a data set copy that is not made by DB2

You can restore a data set to a point of consistency by using a data set copy that was not made by the COPY utility.

After recovery to the point of consistency, if you choose to continue and recover to the current point in time, you do not want RECOVER to begin processing by restoring the data set from a DB2 image copy. Therefore, use the LOGONLY option of RECOVER, which causes RECOVER to skip the RESTORE phase and apply the log records only, starting from the first log record that was written after the data set was backed up.

Because the data sets are restored offline without DB2 involvement, RECOVER LOGONLY checks that the data set identifiers match those that are in the DB2 catalog. If the identifiers do not match, message DSNU548I is issued, and the job terminates with return code 8.

You can use the LOGONLY option on a list of objects.

To ensure that no other transactions can access DB2 objects between the time that you restore a data set and the time that you run RECOVER LOGONLY, follow these steps:

1. Stop the DB2 objects that are being recovered by issuing the following command:

   ```
   -STOP DATABASE(database-name) SPACENAM(space-name)
   ```

2. Restore all DB2 data sets that are being recovered.
3. Start the DB2 objects that are being recovered by issuing the following command:

   ```
   -START DATABASE(database-name) SPACENAM(space-name) ACCESS(UT)
   ```

4. Run the RECOVER utility without the TORBA or TOLOGPOINT parameters and with the LOGONLY parameter to recover the DB2 data sets to the current point in time and to perform forward recovery using DB2 logs. If you want to recover the DB2 data sets to a prior point in time, run the RECOVER utility with either TORBA or TOLOGPOINT, and with the LOGONLY parameters.
5. If you did not recover related indexes in the same RECOVER control statement, rebuild all indexes on the recovered object.
6. Issue the following command to allow access to the recovered object if the recovery completes successfully:

   ```
   -START DATABASE(database-name) SPACENAM(space-name) ACCESS(RW)
   ```

With the LOGONLY option, when recovering a single piece of a multi-piece linear page set, RECOVER opens the first piece of the page set. If the data set is migrated by DFSMShsm, the data set is recalled by DFSMShsm. Without LOGONLY, no data set recall is requested.

Backing up a single piece of a multi-piece linear page set is not recommended. This action can cause a data integrity problem if the backup is used to restore the data set at a later time.

Recovering catalog and directory objects

If you need to recover the catalog and directory, you must recover them before you recover user table spaces. Also, you must recover catalog and directory objects in a specific order.

Before you begin

Before you can recover catalog and directory objects, you must meet the following requirements:

- Ensure that you have applied APAR PI11316 and completed the ++HOLD actions.
- Converting page sets to or from extended 10-byte format during REBUILD INDEX on catalog and directory indexes complicates recovery and might cause failures. To avoid conversions, set the UTILITY_OBJECT_CONVERSION subsystem parameter to NONE until all catalog and directory objects are recovered. Alternatively, specify RBALRSN_CONVERSION NONE on all REBUILD INDEX steps.
- Recovering and rebuilding catalog and directory objects requires installation SYSADM or installation SYSOPR authority.
- If you are performing a recovery at a remote site, start the remote DB2 for z/OS subsystem with ACCESS(MAINT) specified on the START DB2 command and with DEFER ALL specified in the DSNZPARM load module. (See installation panels DSNTIPS and DSNTIPO3.) If DB2 is not started with ACCESS(MAINT), resource unavailable conditions on the real-time statistics (RTS) catalog indexes might occur during REBUILD INDEX(ALL) for the catalog and directory indexes.
- If the logging environment requires adding or restoring active logs, restoring archive logs, or performing any action that affects the log inventory in the BSDS,

you need to recover the BSDS before catalog and directory objects. To copy active log data sets, use the Access Method Services REPRO function.

A full recovery of the catalog and directory is recommended. However, if you need to do a point-time-recovery, be aware of the implications associated with doing point-in-time recovery of the catalog, directory, and user objects. See "Point-in-time recovery of the catalog, directory, and all user objects" on page 491.

About this task

The following table spaces do not have entries in SYSIBM.SYSLGRNX. The indexes that are associated with these table spaces also do not have entries in SYSIBM.SYSLGRNX, even if they were defined with COPY YES. These objects are assumed to be open from the point of their last image copy, so the RECOVER utility processes the log from that point forward.

- DSNDB01.SYSUTILX
- DSNDB01.DBD01
- DSNDB01.SYSLGRNX
- DSNDB06.SYSTSCPY (SYSTSCPY replaces SYSCOPY during enabling-new-function mode processing. The SYSCOPY catalog table space is used in conversion mode until the SYSCOPY table space is replaced during enabling-new-function mode.)
- DSNDB01.SYSDBDXA

Requirement: You must recover the catalog and directory objects in the order that is specified in this task. If you are recovering any subset of the objects in the list, start with the object that is listed first and continue in the order of the list. For example, if you need to recover SYSLGRNX, SYSUTILX, and SYSUSR, recover SYSUTILX first, then SYSLGRNX, and then SYSUSR. You do not need to recover all of the objects; only recover those objects that require recovery.

General guidelines: Use the following general guidelines for all of the steps in this task:

- If you copy your catalog or directory indexes, use the RECOVER utility to recover your indexes. Otherwise, use the REBUILD INDEX utility to rebuild those indexes.
- For all catalog and directory table spaces, you can list the IBM-defined indexes that have the COPY YES attribute in the same RECOVER utility statement.
- Recovery of the items in the list can be done concurrently or included in the same job step. However, the following restrictions apply:
  - When you recover the following table spaces or indexes, the job step in which the RECOVER statement appears must not contain any other utility statements. No other utilities can run while the RECOVER utility is running.
    - DSNDB01.SYSUTILX
    - All indexes on SYSUTILX
    - DSNDB01.DBD01
  - When you recover the following table spaces, no other utilities can run while the RECOVER utility is running. Other utility statements can exist in the same job step.
    - DSNDB06.SYSTSCPY
    - DSNDB01.SYSLGRNX

Special instructions for conversion mode: If the DB2 for z/OS subsystem is in conversion mode, recover the catalog and directory objects in the order that is

defined for Version 10 (DB2 10 for z/OS: Recovering catalog and directory objects) with one change. In step "Recover all of the remaining catalog and directory table spaces," add the following objects:

Table 68. Additional table spaces to recover in conversion mode (CM10)

Additional catalog table spaces to recover in conversion mode (CM10)	
SYSTSOBX	SYSTSVAD
SYSTSQRE	SYSTSVAU
SYSTSQRS	SYSTSIXC
SYSTSVAR	SYSTSSFB
SYSTSVAT	

Procedure

To recover catalog and directory objects:

1. Recover DSNDB01.SYSUTILX.
2. Run REBUILD INDEX(ALL) on DSNDB01.SYSUTILX.
3. Recover DSNDB01.DBD01.
4. Run REBUILD INDEX(ALL) on DSNDB01.DBD01.
5. Recover DSNDB01.SYSDBDXA.
6. Run REBUILD INDEX(ALL) on DSNDB01.SYSDBDXA.
7. Recover DSNDB06.SYSTSCPY.

   If the SYSCOPY table space has not been converted by enabling-new-function mode processing (job DSNTIJEN step ENFM0037), recover DSNDB06.SYSCOPY instead of DSNDB06.SYSTSCPY
8. Run REBUILD INDEX(ALL) on DSNDB06.SYSTSCPY.

   If the SYSCOPY table space has not been converted by enabling-new-function mode processing (job DSNTIJEN step ENFM0037), run REBUILD INDEX(ALL) on DSNDB06.SYSCOPY instead of DSNDB06.SYSTSCPY.
9. Recover DSNDB01.SYSLGRNX.
10. Run REBUILD INDEX(ALL) on DSNDB01.SYSLGRNX.
11. Recover DSNDB06.SYSTSSTG and DSNDB06.SYSTSVOL.
12. Run REBUILD INDEX(ALL) on DSNDB06.SYSTSSTG and DSNDB06.SYSTSVOL.
13. Rebuild any user-defined indexes that are STOGROUP-managed on SYSIBM.SYSCOPY.
14. Recover all of the remaining catalog and directory table spaces in a single RECOVER utility statement with the PARALLEL option.

    The remaining catalog and directory table spaces include the following tables spaces:

    - The directory table spaces in DSNDB01:
      - SCT02
      - SPT01
      - SYSSPUXA
      - SYSSPUXB
    - The catalog table spaces that are listed in the following table:

Table 69. Remaining catalog table spaces to recover in new-function mode

SYSALTER	SYSTSCON	SYSTSPKC	SYSTSSTM
SYSCONTX	SYSTSCTD	SYSTSPKD	SYSTSSYN
SYSDDF	SYSTSCTL	SYSTSPKG	SYSTSTAB
SYSEBCDC	SYSTSCTR	SYSTSPKL	SYSTSTAU
SYSGPAUT	SYSTSDAT	SYSTSPKS	SYSTSTBC
SYSGRTNS	SYSTSDBA	SYSTSPKX	SYSTSTPF
SYSHIST	SYSTSDBR	SYSTSPKY	SYSTSTPT
SYSJAUXA	SYSTSDBU	SYSTSPLA	SYSTSTRG
SYSJAUXB	SYSTSDEP	SYSTSPLD	SYSTSTRT
SYSJAVA	SYSTSENV	SYSTSPLN	SYSTSTSP
SYSPLUXA	SYSTSFAU	SYSTSPLY	SYSTSTSS
SYSPLUXB	SYSTSFLD	SYSTSPRH	SYSTSUNI
SYSROLES	SYSTSFOR	SYSTSPRM	SYSTSVAD
SYSSEQ	SYSTSIPT	SYSTSPTX	SYSTSVAR
SYSSEQ2	SYSTSISS	SYSTSPVR	SYSTSVAT
SYSSTATS	SYSTSIXC	SYSTSQRA	SYSTSVAU
SYSTARG	SYSTSIXR	SYSTSQRE	SYSTSVEW
SYSTSADT	SYSTSIXS	SYSTSQRO	SYSTSVTR
SYSTSASC	SYSTSIXT	SYSTSQRP	SYSTSVWD
SYSTSATS	SYSTSKEY	SYSTSQRS	SYSTSVWT
SYSTSATW	SYSTSKYC	SYSTSQRY	SYSTSXTM
SYSTSATX	SYSTSOBX	SYSTSRAU	SYSTSXTS
SYSTSAUX	SYSTSPDO	SYSTSREL	SYSUSER
SYSTSCHX	SYSTSPDT	SYSTSROU	SYSXML
SYSTSCKD	SYSTSPEN	SYSTSSCM	
SYSTSCKS	SYSTSPHX	SYSTSSFB	
SYSTSCOL	SYSTSPKA	SYSTSSRG	

- If the subsystem is in new-function mode, also recover the catalog table spaces DSNDB06.SYSSTR and DSNDB06.SYSRTSTS.
- If the subsystem is in conversion mode* and the subsystem made it part of the way through the enabling-new-function mode process before going to conversion mode*, also recover the catalog table spaces DSNDB06.SYSSTR and DSNDB06.SYSRTSTS.

15. Run REBUILD INDEX(ALL) on DSNDB06.SYSTSISS and DSNDB06.SYSTSTSS.

    If the SYSRTSTS table space has not been converted by enabling-new-function mode processing (job DSNTIJEN steps ENFM0047), run REBUILD INDEX(ALL) on DSNDB06.SYSRTSTS instead of DSNDB06.SYSTSISS and DSNDB06.SYSTSTSS.

16. Run REBUILD INDEX(ALL) on DSNDB06.SYSTSTSP, DSNDB06.SYSTSTPT, and DSNDB06.SYSTSTAB.

    Execute the following utility statements to rebuild the IBM-defined and any user-defined indexes on the table spaces:

    ```
    REBUILD INDEX (ALL) TABLESPACE DSNDB06.SYSTSTSP
                        RBALRSN_CONVERSION NONE
    REBUILD INDEX (ALL) TABLESPACE DSNDB06.SYSTSTPT
                        RBALRSN_CONVERSION NONE
    REBUILD INDEX (ALL) TABLESPACE DSNDB06.SYSTSTAB
                        RBALRSN_CONVERSION NONE
    ```

17. Rebuild all of the remaining catalog and directory indexes using REBUILD INDEX(ALL) for each table space recovered in step 14 on page 486. Rebuild all user-defined indexes on the catalog that have not been rebuilt or recovered yet.

Results

Messages that you might receive:

DSNU1530I

If you are recovering the catalog and directory during migration to a new version, you might receive message DSNU1530I with RC0. This message is issued if your RECOVER statement or REBUILD INDEX statement specifies a catalog or directory object that no longer exists in the new version or has not yet been created in the new version. In this case, DB2 skips the object. No action is required.

DSNT500I

An ID with a granted authority receives message DSNT500I RESOURCE UNAVAILABLE while trying to recover a table space in the catalog or directory if certain table spaces in the following list are unavailable:

- DSNDB06.SYSTSFAU
- DSNDB06.SYSTSCOL
- DSNDB06.SYSTSTSP
- DSNDB06.SYSTSTPT
- DSNDB06.SYSTSTAB
- DSNDB06.SYSTSIXS
- DSNDB06.SYSTSIXT
- DSNDB06.SYSTSIXR
- DSNDB06.SYSTSIPT
- DSNDB06.SYSTSREL
- DSNDB06.SYSTSFOR
- DSNDB06.SYSTSSYN
- DSNDB06.SYSTSFLD
- DSNDB06.SYSTSTAU
- DSNDB06.SYSTSKEY
- DSNDB06.SYSUSER

If you receive message DSNT500I, you must take one of the following actions:

- Make these table spaces available.
- Run the RECOVER utility on the catalog or directory by using an authorization ID that has the installation SYSADM or installation SYSOPR authority.

DSNT501I

If certain table spaces in DSNDB06 are unavailable when an ID with a granted authority tries to rebuild indexes in the catalog or directory, DB2 issues message DSNT501I.

What to do next

After you recover the DB2 catalog and directory, perform the following actions:

- After a point-in-time recovery on the catalog and directory, run the CHECK DATA utility on the objects to ensure consistency.
- Recover XML scheme repository objects. Although the XML schema repository database, DSNXSR, is not part of the DB2 catalog, you need to recover all table spaces in the DSNXSR database and rebuild all indexes on those table spaces

immediately after you recover the DB2 catalog. If you perform a point-in-time recovery of the catalog, you need to recover objects in the DSNXSR database to the same point in time.

Related concepts:

Management of the bootstrap data set (DB2 Administration Guide)

Related reference:

DB2 catalog tables (DB2 SQL)

DB2 directory tables (DB2 SQL)

Administrative authorities (Managing Security)

-START DB2 (DB2) (DB2 Commands)

Default startup modules panel: DSNTIPO3 (DB2 Installation and Migration)

Databases and spaces to start automatically panel: DSNTIPS (DB2 Installation and Migration)

"Syntax and options of the CHECK DATA control statement" on page 80

"Syntax and options of the OPTIONS control statement" on page 407

"Syntax and options of the REBUILD INDEX control statement" on page 428

"Syntax and options of the RECOVER control statement" on page 460

Related information:

REPRO command (DFSMS Access Method Services for Catalogs)

Objects that contain recovery information

To recover one object, the RECOVER utility must obtain information about it from another object. Therefore, dependencies exist between catalog and directory objects, and you must recover them in a specific order.

The following table lists the objects from which RECOVER must obtain information.

Table 70. Objects that the RECOVER utility accesses

Object name	Reason for access by RECOVER
DSNDB01.SYSUTILX	Utility restart information. The object is not accessed when it is recovered; a RECOVER job for this object is not restartable, and no other commands can be in the same job step. SYSCOPY information for SYSUTILX is obtained from the log. You can use REPORT RECOVERY to obtain SYSCOPY information for DSNDB01.SYSUTILX.

Table 70. Objects that the RECOVER utility accesses (continued)

Object name	Reason for access by RECOVER
DSNDB01.DBD01, DSNDB01.SYSDBDXA	Descriptors for the catalog database (DSNDB06), the work file database (DSNDB07), and user databases. A RECOVER job for this object is not restartable, and no other commands can be in the same job step. SYSCOPY information for DBD01 and SYSDBDXA is obtained from the log. You can use REPORT RECOVERY to obtain SYSCOPY information for DSNDB01.DBD01 and DSNDB01.SYSDBDXA.
DSNDB06.SYSTSCPY	Locations of image copy data sets. This table space contains the SYSIBM.SYSCOPY table. SYSCOPY information for SYSTSCPY itself is obtained from the log. You can use REPORT RECOVERY to obtain SYSCOPY information for DSNDB06.SYSTSCPY.
DSNDB01.SYSLGRNX	The RBA or LRSN of the first log record after the most recent copy.
DSNDB06.SYSTSDBA, DSNDB06.SYSTSDBU, DSNDB06.SYSUSER	Verification that the authorization ID is authorized to run RECOVER.
From several of the following table spaces inDSNDB06: • SYSTSFAU • SYSTSCOL • SYSTSTSP • SYSTSTPT • SYSTSTAB • SYSTSIXS • SYSTSIXT • SYSTSIXR • SYSTSIPT • SYSTSREL • SYSTSFOR • SYSTSSYN • SYSTSFLD • SYSTSTAU • SYSTSKEY	Information about table spaces that are to be recovered.

Related concepts:

"REPORT output" on page 700

Related reference:

"Syntax and options of the REPORT control statement" on page 695

Point-in-time recovery of the catalog, directory, and all user objects

Full recovery of the catalog and directory table spaces and indexes is strongly recommended. However, in some situations, you might need to do a point-in-time recovery. In this case, you should understand the implications and plan for this type of recovery.

When you recover the DB2 catalog, directory, and all user objects, consider the entire catalog and directory, including all table spaces and index spaces, to be one logical unit. Recover all objects in the catalog, directory, and all user objects to the same point of consistency. If you plan to do a point-in-time recovery of the catalog, directory, and all user objects, a separate quiesce of the DSNDB06.SYSTSCPY table space is required after a quiesce of the other catalog and directory table spaces.

The enabling-new-function mode process changes catalog and directory objects from BASIC format to EXTENDED format. Point-in-time recoveries of these objects need to be recovered in the correct format. Systems that are recovered during conversion mode must be recovered to a point-in-time when the catalog and directory were in BASIC mode. After the BSDS is converted to extended mode, the catalog and directory must be recovered in EXTENDED mode. During the enabling-new-function mode process and up to the conversion of the BSDS, catalog objects might exist in both BASIC and EXTENDED format.

A point-in-time recovery on catalog and directory objects bypasses the checking for the following items:

- A complete referential integrity (RI) set. If the complete RI set is not recovered together, CHKP is not set on the dependents.
- A complete base and LOB set. If base and LOB objects are not recovered together, ACHKP or CHKP is not set.

Recommendation: Before you recover the DB2 catalog, directory, and all user objects to a prior point in time, shut down the DB2 subsystem cleanly and then restart the subsystem in ACCESS(MAINT) mode. Recover the catalog and directory objects to the point in time. You can use sample queries and documentation, which are provided in DSNTESQ in the SDSNSAMP sample library, to check the consistency of the catalog.

If you perform a point-in-time recovery on catalog and directory table spaces, the indexes are placed in RBDP (rebuild-pending) status. Use the CHECK INDEX utility to determine whether an index is inconsistent with the data that it indexes. You can use the REBUILD INDEX utility to rebuild the indexes. Alternatively, you can use the RECOVER utility to recover catalog and directory indexes if the index was defined with the COPY YES attribute and if you have a full index image copy.

Related concepts:

"Point-in-time recovery" on page 494

Related reference:

-START DB2 (DB2) (DB2 Commands)

"Syntax and options of the CHECK INDEX control statement" on page 110

"Syntax and options of the REBUILD INDEX control statement" on page 428

"Syntax and options of the RECOVER control statement" on page 460

Appendix C, "Advisory or restrictive states," on page 1103

SYSIBM.SYSLGRNX table (DB2 SQL)

Creating a point of consistency for catalog and directory objects

Full recovery of the catalog and directory table spaces and indexes is strongly recommended. However, if you need to plan for point-in-time recovery of the catalog and directory, you should create a point of consistency for the catalog and directory.

Procedure

To create a point of consistency for catalog and directory objects:

1. Quiesce all catalog and directory table spaces, except for DSNDB06.SYSTSCPY and DSNDB01.SYSUTILX.

   You can use the LISTDEF utility to group these table spaces into a single list and then specify that list in the QUIESCE statement.
2. Quiesce DSNDB06.SYSTSCPY.

   Recommendation: Quiesce DSNDB06.SYSTSCPY in a separate utility statement. When you recover DSNDB06.SYSTSCPY to its own quiesce point, it contains the SYSCOPY records with ICTYPE = 'Q' (quiesce) for the other catalog and directory table spaces.
3. Quiesce DSNDB01.SYSUTILX in a separate job step.

What to do next

Later, if you need to recover to a point in time, recover DSNDB06.SYSTSCPY and DSNDB01.SYSUTILX to their own quiesce points, and recover other catalog and directory table spaces to their common quiesce point. The catalog and directory objects must be recovered in the prescribed order for your version of DB2 for z/OS.

Related tasks:

"Recovering catalog and directory objects" on page 484

Related reference:

DB2 catalog tables (DB2 SQL)

DB2 directory tables (DB2 SQL)

"Syntax and options of the QUIESCE control statement" on page 416

SYSIBM.SYSCOPY table (DB2 SQL)

SYSIBM.SYSUTILX table (DB2 SQL)

Chapter 19, "LISTDEF," on page 221

Reinitializing DSNDB01.SYSUTILX

You need to reinitialize the DSNDB01.SYSUTILX directory table space if you cannot successfully execute the DISPLAY UTILITY and TERMINATE UTILITY commands. In this case, DSNDB01.SYSUTILX is damaged and you cannot recover DSNDB01.SYSUTILX, because errors occur in the LOGAPPLY phase.

About this task

Because DSNDB01.SYSUTILX contains information about active and outstanding utilities, the process of reinitializing this table space involves determining which objects have a utility in progress and resolving any pending states to make the object available for access.

Procedure

If DSNDB01.SYSUTILX must be reinitialized, use the following procedure with caution:

1. Issue the **-DIS DB(*) SPACENAM(*) RESTRICT** command and analyze the output. Write down the following items:
   - All of the objects with a utility in progress (The objects in UTUT, UTRO, or UTRW status have utilities in progress.)
   - Any pending states for these objects (RECP, CHKP, and COPY are examples of pending states.
2. Run the following utility statement to reset the SYSUTILX table space:

   CATMAINT UPDATE UTILX RESET
   Initialize SYSUTILX and its indexes.
3. Issue the -START DB(*dbname*) ACCESS(UT) command for each database that has objects with a utility in progress.
4. Issue the -START DB(*dbname*)SPACENAM(*spname*) ACCESS(FORCE) command on each object with a utility in progress. This action clears all utilities that are in progress or in pending states. (Any pending states are cleared, but you still need to resolve the pending states as directed in the next step.)
5. Resolve the pending states for each object by running the appropriate utility. For example, if an object was in the RECP status, run the RECOVER utility.
6. Issue -START DB(*dbname*) ACCESS(RW) for each database.

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Recovering a table space that contains LOB or XML data

The RECOVER utility can set the auxiliary warning status for a LOB table space or XML table space if it finds at least one invalid LOB or XML column.

DB2 marks a LOB or XML column invalid if all of the following conditions are true:

- The LOB table space or XML table space was defined with the LOG(NO) attribute.
- The LOB table space or XML table space was recovered.
- The LOB or XML was updated since the last image copy.

The status of an object that is related to a LOB or XML table space can change due to a recovery operation, depending on the type of recovery that is performed. If all of the following objects for all LOB or XML columns are recovered in a single RECOVER utility statement to the present point in time, no pending status exists:

- Base table space
- Index on the auxiliary table
- LOB table space
- XML table space

The RECOVER utility verifies that all related objects that are required to perform a point-in-time recovery are included in the RECOVER control statement. The VERIFYSET keyword enables you to control whether a point-in-time recovery requires all base, LOB, XML, and history objects in a set. You can choose to break up point-in-time recoveries into multiple jobs with VERIFYSET NO.

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Recovering a table space that contains clone objects

The recovery guidelines and considerations for a cloned table space or cloned index are the same as for a base table space or base index except in the point-in-time recovery case.

For an object currently involved in cloning, or one that was previously involved in cloning, a point-in-time recovery cannot be done to a time the precedes the most recent EXCHANGE statement. The time of the most recent EXCHANGE for a table space can be determined by querying SYSIBM.COPY for the table space to be recovered where ICTYPE = 'A' and STYPE = 'E'.

When an EXCHANGE is done, two rows will be written to SYSIBM.SYSCOPY for the table space being processed: one for the base object and one for the clone object. These rows are differentiated by the SYSCOPY.INSTANCE column value: one will have INSTANCE=1 and the other INSTANCE=2. These SYSIBM.SYSCOPY rows do not indicate base or clone. The SYSIBM.SYSTABLESPACE catalog table contains an INSTANCE column that indicates the instance number of the current base objects. The SYSTABLESPACE.INSTANCE column value can be used to determine which SYSIBM.SYSCOPY row is for a base object and which is for a clone object.

Point-in-time recovery

Recovering data to a prior time is a *point-in-time recovery*. You can recover objects to a particular RBA, LRSN, or image copy. You can do this type of recovery by using the RECOVER utility *point-in-time recovery options*. These options are TOCOPY, TOLOGPOINT, TOLASTCOPY, TORBA, and TOLASTFULLCOPY.

You can recover objects to any RBA or LRSN by using TORBA or TOLOGPOINT. You can recover objects to a previous image copy by using TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY. The exception is objects that are currently, or were previously, involved with cloning. For these objects, you cannot recover them to a point in time that precedes the most recent EXCHANGE statement.

When you recover objects to an RBA or LRSN, the RBA or LRSN does not have to be a consistent point in time. The RECOVER utility automatically handles any uncommitted units of work and the data is left in a consistent state.

When you recover objects to an image copy, whether the image copy is a consistent point in time depends on the type of image copy. An image copy that was taken with SHRLEVEL REFERENCE is a point of consistency. An image copy that was taken with SHRLEVEL CHANGE is not an explicit point of consistency.

Another explicit point of consistency is a *quiesce point*, which is a point at which data is consistent as a result of running the DB2 QUIESCE utility.

Recoveries to a consistent point in time are the most efficient because no uncommitted units of work need to be backed out.

Recommendation: If you use the RECOVER utility to recover data to an image copy by specifying TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY, specify a copy that was made with the SHRLEVEL REFERENCE option.

To achieve consistency when you want to recover to a copy that was taken with SHRLEVEL CHANGE, specify a recovery point immediately after the copy completed. To find this point, locate a record for the SHRLEVEL CHANGE copy in SYSIBM.SYSCOPY and use the value in the PIT_RBA column. Specify that recovery point by using the TORBA or TOLOGPOINT options in the RECOVER statement.

You do not need to take a full image copy after you recover data to a point in time, except in the case of fallback recovery. DB2 records the RBAs or LRSNs that are associated with the point-in-time recovery in the SYSIBM.SYSCOPY catalog table to allow future recover operations to skip the unwanted range of log records.

If you specify the TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY option to recover data to a point in time, RECOVER puts any associated index spaces in REBUILD-pending status. If you specify the TOLOGPOINT or TORBA option to recover data to a point in time, RECOVER puts any associated index spaces in REBUILD-pending status if the indexes are not recovered in the same RECOVER statement as their corresponding table space. The reason is that a point-in-time recovery of only the table space leaves data in a consistent state and indexes in an inconsistent state.

You can remove the REBUILD-pending state in one of the following ways:

- Run REBUILD INDEX on the indexes.
- Run RECOVER to a point in time on the indexes. If you do that, DB2 sets the CHECK-pending state on the indexes, because the table space was not recovered in the same RECOVER utility statement as the indexes.

If you use a point-in-time recovery option to recover a single data set of a nonpartitioned table space, DB2 issues message DSNU520I to warn that the table space can become inconsistent following the RECOVER job. This point-in-time recovery can cause compressed data to exist without a dictionary or can even overwrite the data set that contains the current dictionary.

If you use the point-in-time recovery option to recover a partition-by-growth table space that has an image copy with fewer partitions than the current table space, any excess partitions (partitions that are currently defined but not in the image copy) are empty after the RECOVER processing.

If a table space or partition in reordered row format is recovered to a point in time when the table space or partition was in basic row format, the table space or partition reverts to basic row format after RECOVER processing. Similarly, if a table space or partition in basic row format is recovered to a point in time when the table space or partition was in reordered row format, the table space or partition revert to reordered row format after RECOVER processing.

After recovering a set of table spaces to a point in time, you can use CHECK DATA to check for inconsistencies.

If you use the RECOVER utility to recover a table space set to a point-in-time, you must ensure that you recover the entire set of table spaces to the same point in time. If you do not include every member of the set, or if you do not recover the entire set to the same point in time, RECOVER sets the auxiliary CHECK-pending status on for all table spaces in the set.

You can also use point-in-time recovery and the point-in-time recovery options to recover all user-defined table spaces and indexes that are in refresh-pending status (REFP).

Recommendation: After running any point-in-time recoveries, run REORG TABLESPACE and REBUILD INDEX to reset the real-time statistics. For more information about the affect of point-in-time recoveries on real-time statistics, see "Effects of running RECOVER" on page 508.

Restriction: RECOVER cannot use system-level backups as a recovery base unless DFSMShsm is at z/OS 1.8 or higher.

Backing out work to a point-in-time

The RECOVER utility can recover your data to a point in time by backing out committed work from the current state of the data. To recover data by backing out, specify BACKOUT YES on the RECOVER control statement.

In some circumstances, recovering to a point in time by backing out work can be faster than recovering to a point in time by restoring a copy of the data and applying the logs forward.

When the RECOVER utility performs a point-in-time recovery by backing out committed work, the recovery is a point-in-time recovery with consistency, because any work that was uncommitted at the point in time to which the data is being recovered is also backed out. When the recovery is complete, the data is left in a transaction consistent state.

Restrictions: You cannot perform a backout recovery to the following points in time:

- A point in time that is earlier than the timestamp of the latest SQL ALTER record in SYSIBM.SYSCOPY for the object being recovered.
- A point-in-time that is earlier than the completion time of a previous backout recovery.
- A point-in-time before a utility that inserts SYSCOPY records was run, unless the utility is COPY or COPYTOCOPY.
- A point-in-time before REORG TABLESPACE with the LOG(YES) option was run on the table space.

Before running the RECOVERY utility with the BACKOUT YES option, run the REPORT utility with the RECOVER option on the object being recovered to identify events that might prevent you from recovering the object by backing out work to a given point in time.

Recovery considerations after rebalancing partitions with REORG

For partitioned table spaces, image copies that were taken before a REORG job that materialized limit key changes are not usable for recovering to a current RBA or LRSN. Avoid recovering a partitioned table space to a point-in-time that is after the REORG-pending or advisory REORG-pending status was set but before the REORG that redistributed data records. To determine an appropriate point in time:

1. Run REPORT RECOVERY.

2. Select an image copy for which the recovery point is a point after the REORG that redistributed data records.

Suppose that you run the REORG utility to turn off a REORG-pending status, and then recover to a point in time before that REORG job. In this case,DB2 sets restrictive statuses on all partitions that you specified in the REORG job, as follows:

- Sets REORG-pending (and possibly CHECK-pending) on for the data partitions
- Sets REBUILD-pending on for the associated index partitions
- Sets REBUILD-pending on for the associated logical partitions of nonpartitioned secondary indexes

To create a new consistent recovery point, take one of the following actions immediately after an ALTER INDEX, ALTER TABLE, or REORG REBALANCE operation that changes partition boundaries:

- Run REORG with the COPYDDN and SHRLEVEL NONE options.
- Take a full image copy immediately after REORG completes.

Using offline copies to recover after rebalancing partitions

To recover data after a REORG job redistributes the data among partitions, use RECOVER LOGONLY. If you perform a point-in-time recovery, you must keep the offline copies synchronized with the SYSCOPY records. Therefore, do **not** use the MODIFY RECOVERY utility to delete any SYSCOPY records with an ICTYPE column value of 'A' because these records might be needed during the recovery. Delete these SYSCOPY records only when you are sure that you no longer need to use the offline copies that were taken before the REORG that performed the rebalancing.

Actions that can affect recovery status

When you perform the following actions before you recover a table space, the recovery status is affected as described:

- If you alter a table to rotate partitions:
  - You can recover the partition to the current time.
  - You can recover the partition to a point in time after the alter. The utility can use a recovery base, (for example, a full image copy, a REORG LOG YES operation, or a LOAD REPLACE LOG YES operation) that occurred before the alter.
  - You cannot recover the partition to a point in time before the alter; the recover fails with MSGDSNU556I and RC8.
- If you change partition boundaries with ALTER or REORG REBALANCE:
  - You can recover the partition to the current time if a recovery base (for example, a full image copy, a REORG LOG YES operation, or a LOAD REPLACE LOG YES operation) exists.
  - You can recover the partition to a point in time after the change.
  - You can recover the partitions that are affected by the boundary change to a point in time before the materialization of those changes by the REORG TABLESPACE utility. However, after the RECOVER utility completes successfully, the affected partitions with the limit key changes are placed in REORG-pending (REORP) status. You then need to then run REORG TABLESPACE to correctly redistribute the data according to the previous limit key values.
- If you alter a table to add a partition:
  - You can recover the partition to the current time.

  - You can recover the partition to a point in time after the alter.
  - You can recover the partition to a point in time before the alter; RECOVER resets the partition to be empty.
- If you alter a table to add a column (by using ALTER TABLE ADD COLUMN) and subsequently drop the default value of the column (by using ALTER COLUMN DROP DEFAULT), you cannot recover the table space to a point in time between those two events.
- If you convert a table space from basic row format to reordered row format, you cannot recover a piece of the table space to a point in time when the table space was in basic row format. Similarly, if you convert a table space from reordered row format to basic row format, you cannot recover a piece of the table space to a point in time when the table space was in reordered row format. In both cases, you must recover the entire table space.
- If you regenerate an index (by using ALTER INDEX REGENERATE), you cannot recover the index or index space to a point in time prior to the time that it was regenerated. Instead, rebuild the index by using the REBUILD INDEX utility.
- If you alter an index such that DB2 creates a new version of the index, you cannot recover the index to a point in time prior to the first ALTER INDEX that created a new version of that index.
- If you convert a table to support multiple XML versions:
  - You cannot recover the associated table space to a point in time before the table was converted.
  - You cannot recover any indexes for that table to a point in time before the table was converted.
- If you alter the organization of your table space to hash organization:
  - You can recover the table space to the current time.
  - You can recover the table space to a point in time before or after the alter.
  - You can recover the table space to a point in time before or after the REORG that materialized the hash organization. RECOVER places the table space in AREOR status if the table space was recovered to a point before the REORG.
- If you alter the size of the hash space in your table space:
  - You can recover the table space to the current time.
  - You can recover the table space to a point in time before or after the alter.
  - You can recover the table space to a point in time before or after the REORG that materialized the change in hash space size.
- If you drop the hash organization (using ALTER):
  - You can recover the table space to the current time.
  - You can recover the table space to a point in time after the alter.
  - You cannot recover the table space to a point in time before the alter.
- If you execute pending definition changes, you must materialize or drop those changes before you can perform a point-in-time recovery.

  Examples of pending definition changes are ALTER statements that perform the following operations:
  - Change the segment size
  - Change the data set size
  - Change the buffer pool page size
  - Change the MEMBER CLUSTER attribute
  - Change the table space type
  - Change the limit key values
  - Drop columns
- You cannot recover to a point in time before materialization of a pending definition change that results from an ALTER statement with DROP COLUMN.
- If you perform any of the following SQL operations on a table in a segmented table space or universal table space, you cannot back out the changes using RECOVER with BACKOUT YES:
  - DELETE without a WHERE clause (mass DELETE)

– TRUNCATE TABLE
– DROP TABLE
– ALTER TABLE ROTATE PARTITION

If you perform any of the previously indicated actions on tables in a base table space that has indexes or auxiliary objects (LOB tables spaces, or XML table spaces), this restriction also applies to those indexes or auxiliary objects.

When you perform the following actions before you recover an index to a prior point in time or to the current time, the recovery status is affected as described:

- If you alter the data type of a column to a numeric data type, you cannot recover the index until you take a full image copy of the index. However, the index can be rebuilt.
- If you alter an index to NOT PADDED or PADDED , you cannot recover the index until you take a full image copy of the index. However, the index can be rebuilt.

Planning for point-in-time recovery

Recovering to a point in time that is a point of consistency (QUIESCE or SHRLEVEL REFERENCE set) is desirable because there will be no uncommitted work to back out.

When making copies of a single object, use SHRLEVEL REFERENCE to establish consistent points for TOCOPY, TOLASTCOPY, or TOLASTFULLCOPY recovery. Copies that are made with SHRLEVEL CHANGE do not copy data at a single instant because changes can occur as the copy is made. A subsequent RECOVER TOCOPY operation can produce inconsistent data. Instead use RECOVER with the TOLOGPOINT option to identify a point after the SHRLEVEL CHANGE copy and any uncommitted units of work will be backed out.

When copying a list of objects, use SHRLEVEL REFERENCE. If a subsequent recovery to a point in time is necessary, you can use a single RECOVER utility statement to list all of the objects, along with TOLOGPOINT to identify the common RBA or LRSN value. If you use SHRLEVEL CHANGE to copy a list of objects, you should follow it with a QUIESCE of the objects.

To improve the performance of the recovery, take a full image copy of the table space or set of table spaces, and then quiesce them by using the QUIESCE utility. This action enables RECOVER TORBA or TOLOGPOINT to recover the table spaces to the quiesce point with minimal use of the log.

Authorization: Restrict use of the point-in-time recovery options to personnel with a thorough knowledge of the DB2 recovery environment.

Ensuring consistency

You can use RECOVER TORBA, RECOVER TOLOGPOINT, and RECOVER TOCOPY to recover one of the following single objects:

- Partition of a partitioned table space
- Partition of a partitioning index space
- Data set of a simple table space

For any of the previously listed objects, restore all data sets to the same level; otherwise, the data becomes inconsistent.

If possible, specify a table space and all of its indexes (or a set of table spaces and all related indexes) in the same RECOVER utility statement, and specify TOLOGPOINT or TORBA to identify a QUIESCE point. This action avoids placing indexes in the CHECK-pending or REBUILD-pending status. If the TOLOGPOINT is not a common QUIESCE point for all objects, use the following procedure:

1. RECOVER table spaces to the value for TOLOGPOINT (either an RBA or LRSN).
2. Use concurrent REBUILD INDEX jobs to recover the indexes over each table space.

This procedure ensures that the table spaces and indexes are synchronized, and it eliminates the need to run the CHECK INDEX utility.

If you cannot specify TOLOGPOINT or TORBA to identify a QUIESCE point, you can specify any point in time, and DB2 will leave the data in a consistent state. The RECOVER utility automatically handles any uncommitted units of work and leaves the data in a consistent state when TORBA or TOLOGPOINT is specified.

When using RECOVER with the TORBA or TOLOGPOINT option, ensure that all of the objects that are changed by the active units of recovery at the recovery point are recovered to the same point-in-time so that they are synchronized:

- DB2 rolls back changes made to units of recovery that are inflight, inabort, postponed abort, or indoubt during the recovery point-in-time.
- DB2 does not roll back changes made to units of recovery that are INCOMMIT during the recovery point-in-time.
- DB2 rolls back only changes to objects in the RECOVER statement.

Avoiding CHECK-pending status

DB2 sets CHECK-pending status in the following point-in-time-recovery situations:

- You recover at least one member of a table space set to a prior point in time, but you do not recover all members of the table space set to the same quiesce point. In this case, all dependent table spaces that are recovered are placed in CHECK-pending status with the scope of the whole table space. All dependent table spaces of the recovered table spaces are placed in CHECK-pending status with the scope of the specific dependent tables.
- The RECOVER statement contains the TORBA option or TOLOGPOINT option and recovers all members of a table space set to the same point in time. However, referential constraints were defined in one of those table spaces after that point in time. In this case, the CHECK-pending status is set for the table space that contains the table with the referential constraint.
- The RECOVER statement contains the TORBA option or TOLOGPOINT option and recovers one or more indexes to a previous point in time. However, the same RECOVER statement does not recover the related table space. In this case, DB2 sets the CHECK-pending status for the indexes.

RECOVER does not place dependent table spaces that are related by informational referential constraints into CHECK-pending status.

To avoid setting CHECK-pending status, take the following actions:

- When you recover tables that are involved in a referential constraint, recover all of the table spaces that are involved in the constraint.
- Recover all dependent objects to the same point in time.

- Do not add table check constraints or referential constraints after the point in time to which you want to recover.
- Recover indexes and the related table space to the same point in time (preferably a quiesce point) or COPY SHRLEVEL REFERENCE point. RECOVER processing resets the CHECK-pending status for all indexes in the same RECOVER statement.

Related information:

Recovery of table space sets (DB2 Administration Guide)

"CHECK-pending status" on page 1105

Compressed data

Use caution when recovering a portion of a table space or partition (for example, one data set) to a prior point in time. If the data set that is being recovered has been compressed with a different dictionary, you can no longer read the data.

Recovery to a point in time before materialization of pending definition changes

You can recover a range-partitioned table space, a LOB table space, or an XML table space to a point in time before a REORG job was run to materialize pending definition changes. However, the REORG job that materialized the changes must have been run in DB2 Version 11 new-function mode.

Restriction: For a list of restrictions on recovery to a point in time before materialization of pending definition changes, see Chapter 27, "RECOVER," on page 457.

Before you run RECOVER to a point in time that is before materialization of pending definition changes, run REPORT RECOVERY to obtain:

- The recovery history from the SYSIBM.SYSCOPY catalog table
- The log ranges from the SYSIBM.SYSLGRNX directory table

After you run RECOVER to a point in time that is before materialization of pending definition changes, the target table space is put in the REORG-pending state. You must run REORG on the entire table space to remove the REORG-pending state and complete the recovery process.

Related concepts:

"How the RECOVER utility performs fallback recovery" on page 506

Recovery of data to a prior point in time (DB2 Administration Guide)

"Resetting the REBUILD-pending status" on page 451

Related tasks:

Compressing your data (DB2 Performance)

Materializing pending definition changes (DB2 Administration Guide)

"Reviewing CHECK INDEX output" on page 123

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

"REBUILD-pending status" on page 1109

"Syntax and options of the RECOVER control statement" on page 460

"REORG-pending status" on page 1111

Avoiding specific image copy data sets during a recovery

You might accidentally lose an image copy, or you might want to avoid a specific image copy data set. Because the corresponding row is still present in SYSIBM.SYSCOPY, the RECOVER utility always attempts to allocate the data set.

Use the RESTOREBEFORE option and specify the RBA or LRSN of the image copy, concurrent copy, or system-level backup that you want to avoid, and RECOVER will search for an older recovery base. The RECOVER utility then applies log records to restore the object to its current state or the specified TORBA or TOLOGPOINT value.

Image copy on tape

If the image copy is on tape, messages IEF233D and IEF455D request the tape for RECOVER, as shown in the following example:

```
 IEF233D M BAB,COPY   ,,R92341QJ,DSNUPROC,
         OR RESPOND TO IEF455D MESSAGE
*42 IEF455D MOUNT COPY    ON BAB FOR R92341QJ,DSNUPROC OR REPLY 'NO'
 R 42,NO
 IEF234E K BAB,COPY    ,PVT,R92341QJ,DSNUPROC
```

By replying NO, you can initiate the fallback to the previous image copy. RECOVER responds with messages DSNU030I and DSNU508I, as shown in the following example:

```
DSNU030I    csect-name - UNABLE TO ALLOCATE R92341Q.UTQPS001.FCOPY010
                         RC=4, CODE=X'04840000'
DSNU508I    csect-name - IN FALLBACK PROCESSING TO PRIOR FULL IMAGE COPY
```

Reason code X'0484' means that the request was denied by the operator.

Image copy on disk:

If the image copy is on disk, you can delete or rename the image copy data set before RECOVER starts executing. RECOVER issues messages DSNU030I and DSNU508I, as shown in the following example:

```
DSNU030I    csect-name - UNABLE TO ALLOCATE R92341Q.UTQPS001.FCOPY010,
                         RC=4, CODE=X'17080000'
DSNU508I    csect-name - IN FALLBACK PROCESSING TO PRIOR FULL IMAGE COPY
```

Reason code X'1708' means that the ICF catalog entry cannot be found.

How to improve RECOVER performance

You can improve the performance of the RECOVER utility by taking certain actions.

To improve recovery time, consider recovering to a quiesce point or SHRLEVEL REFERENCE copy instead of recovering to any point in time. The following factors impact performance when you recover to a non quiesce point:

- The duration of the units of recovery that were active at the recovery point.
- The number of DB2 members that have active units of recovery to roll back.

Use MERGECOPY to merge your table space image copies before recovering the table space. If you do not merge your image copies, RECOVER automatically merges them. If RECOVER cannot allocate all the incremental image copy data sets when it merges the image copies, RECOVER uses the log instead.

Include a list of table spaces and indexes in your RECOVER utility statement to apply logs in a single scan of the logs.

If you use RECOVER TOCOPY for full image copies, you can improve performance by using data compression. The improvement is proportional to the degree of compression.

Consider specifying the PARALLEL keyword to restore image copies from disk or tape to a list of objects in parallel.

If you are recovering concurrent copies, consider specifying the CURRENTCOPYONLY option to improve performance. When you specify this option, RECOVER can issue one DFSMSdss RESTORE command for multiple objects. The utility issues one RESTORE command for each group of objects that is associated with the concurrent copy data set. If you do not use the CURRENTCOPYONLY keyword, RECOVER issues one RESTORE command for each object.

If you are recovering an object from a system-level backup, RECOVER invokes DFSMShsm, which controls parallelism. If the system-level backup resides on disk, the RECOVER utility passes the object to DFSMShsm before processing the objects to be restored from image copies or concurrent copies. If the system-level backup resides on tape, the RECOVER utility processes the objects to be restored from system-level backups, image copies, and concurrent copies at the same time.

Recovery from a FlashCopy image copy with consistency or from a sequential image copy with consistency might take longer due to the additional processing required to read the logs and apply any changes made after the point of consistency.

Optimizing the LOGAPPLY phase

The time that is required to recover a table space depends also on the time that is required to read and apply log data. You can take several steps to optimize the process. If possible, DB2 reads the required log records from the active log to provide the best performance.

Any log records that are not found in the active logs are read from the archive log data sets, which are dynamically allocated to satisfy the requests. The type of storage that is used for archive log data sets is a significant factor in the performance. Consider the following actions to improve performance:

- RECOVER a list of objects in one utility statement to take only a single pass of the log.
- Keep archive logs on disk to provide the best possible performance.
- Control archive logs data sets by using DFSMShsm to provide the next best performance. DB2 optimizes recall of the data sets. After the data set is recalled, DB2 reads it from disk.
- If the archive log must be read from tape, DB2 optimizes access by means of ready-to-process and look-ahead mount requests. DB2 also permits delaying the

deallocation of a tape drive if subsequent RECOVER jobs require the same archive log tape. Those methods are described in more detail in the subsequent paragraphs.

The BSDS contains information about which log data sets to use and where they reside. You must keep the BSDS information current. If the archive log data sets are cataloged, the ICF catalog indicates where to allocate the required data set.

DFSMShsm data sets

The recall of the first DFSMShsm archive log data set starts automatically when the LOGAPPLY phase starts. When the recall is complete and the first log record is read, the recall for the next archive log data set starts. This process is known as *look-ahead* recalling. Its purpose is to recall the next data set while it reads the preceding one.

When a recall is complete, the data set is available to all RECOVER jobs that require it. Reading proceeds in parallel.

Non-DFSMShsm tape data sets

DB2 reports on the console all tape volumes that are required for the entire job. The report distinguishes two types of volumes:

- Any volume that is **not** marked with an asterisk (*) is **required** for the for the job to complete. Obtain these volumes from the tape library as soon as possible.
- Any volume that **is** marked with an asterisk (*) contains data that is also contained in one of the active log data sets. The volume might or might not be required.

As tapes are mounted and read, DB2 makes two types of mount requests:

- *Ready-to-process*: The current job needs this tape immediately. As soon as the tape is loaded, DB2 allocates and opens it.
- *Look-ahead*: This is the next tape volume that is required by the current job. Responding to this request enables DB2 to allocate and open the data set before it is needed, thus reducing overall elapsed time for the job.

You can dynamically change the maximum number of input tape units that are used to read the archive log by specifying the COUNT option of the SET ARCHIVE command. For example, use the following command to assign 10 tape units to your DB2 subsystem:

```
-SET ARCHIVE COUNT (10)
```

The DISPLAY ARCHIVE READ command shows the currently mounted tape volumes and their statuses.

Delayed deallocation

DB2 can delay deallocating the tape units used to read the archive logs. This is useful when several RECOVER utility statements run in parallel. By delaying deallocation, DB2 can re-read the same volume on the same tape unit for different RECOVER jobs, without taking time to allocate it again.

You can dynamically change the amount of time that DB2 delays deallocation by using the TIME option of the SET ARCHIVE command. For example, to specify a 60 minute delay, issue the following command:

```
-SET ARCHIVE TIME(60)
```

In a data sharing environment, you might want to specify zero (0) to avoid having one member hold onto a data set that another member needs for recovery.

Performance summary

1. Achieve the best performance by allocating archive logs on disk.
2. Consider staging cataloged tape data sets to disk before allocation by the log read process.
3. If the data sets are read from tape, set both the COUNT and the TIME values to the maximum allowable values within the system constraints.

Recovering image copies in a JES3 environment

You can recover sequential or concurrent image copies in a JES3 environment.

Procedure

To recover image copies in a JES3 environment:

Ensure that sufficient units are available to mount the required image copies. In a JES3 environment, if the number of image copies that need to be restored exceeds the number of available online and offline units, and the RECOVER job successfully allocates all available units, the job waits for more units to become available.

Resetting RECOVER-pending or REBUILD-pending status

Several possible operations on a table space can place the table space in the RECOVER-pending status and the index space in REBUILD-pending status.

Procedure

To reset RECOVER-pending or REBUILD-pending status:

Use one of the following methods:

- Recover the table space, index space, or partition.
- Use REBUILD INDEX to rebuild the index space from existing data.
- Use the LOAD utility, with the REPLACE option, on the table space or partition.
- Use the REPAIR utility, with the NORCVRPEND option, on the table space, index space, or partition. Be aware that the REPAIR utility does not fix the data inconsistency in the table space or index.
- Rebuild indexes, run REORG TABLESPACE SORTDATA for table spaces and indexes.

Related reference:

"REBUILD-pending status" on page 1109

"RECOVER-pending status" on page 1110

Chapter 26, "REBUILD INDEX," on page 427

Chapter 29, "REORG TABLESPACE," on page 551

Chapter 30, "REPAIR," on page 663

How the RECOVER utility allocates incremental image copies

RECOVER attempts to dynamically allocate all required incremental image copy data sets.

If any of the incremental image copies are missing, RECOVER performs the following actions:

- Identifies the first incremental image copy that is missing
- Uses the incremental image copies up to the missing incremental image copy
- Doesn't use the remaining incremental image copy data sets
- Applies additional log records to compensate for any incremental image copies that were not used

For example, if the incremental image copies are on tape and an adequate number of tape drives are not available, RECOVER does not use the remaining incremental image copy data sets.

How the RECOVER utility performs fallback recovery

The RECOVER utility attempts to use the latest primary copy data set as a starting point for recovery. If the latest primary copy data set is not available, RECOVER attempts to use the backup copy data set, if one is available.

If neither image copy is usable, RECOVER attempts to fall back to a previous recovery point. If the previous recovery point is a full image copy, the RECOVER utility uses the full image copy, any incremental image copies, and the log to recover. If a previous REORG LOG YES or LOAD REPLACE LOG YES was done, RECOVER attempts to recover from the log and applies any changes that occurred between the two image copies. If good full image copies are not available, and no previous REORG LOG YES or LOAD REPLACE LOG YES jobs were run, the RECOVER utility terminates. The RECOVER utility will not fall back to a system-level backup.

If one of the following actions occurs, the index remains untouched, and utility processing terminates with return code 8:

- RECOVER processes an index for which no full copy exists.
- The copy cannot be used because of utility activity that occurred on the index or on its underlying table space,

If you always make multiple image copies, RECOVER should seldom fall back to an earlier point. Instead, RECOVER relies on the backup copy data set if the primary copy data set is unusable.

In a JES3 environment, you can do a fallback recovery by issuing a JES3 `cancel,s` command at the time the allocation mount message is issued. This action might be necessary if a volume is not available or if you do not want the given volume.

RECOVER does not perform parallel processing for objects that are in backup or fallback recovery. Instead, the utility performs nonparallel image copy allocation processing of the objects. RECOVER defers the processing of objects that require backup or fallback processing until all other objects are recovered, at which time the utility processes the objects one at a time.

Related concepts:

"Preparing for recovery by using the COPY utility" on page 175

How the RECOVER utility retains tape mounts

The RECOVER utility can automatically retain the tape volumes for the input image copies when a list of objects is being recovered.

For input image copies (for the objects being recovered) that are stacked on one or more tape volumes, you do not need to code JCL DD statements to retain the tape volumes on the tape drive. Instead, you can use the PARALLEL and TAPEUNITS keywords. The PARALLEL keyword directs the RECOVER utility to process the objects in parallel. The objects will be sorted based on how the input image copies are stacked on tape to maximize efficiency during the RESTORE phase by retaining the tape volumes on the tape drive and by restoring the input image copies in the right order (by ascending file sequence numbers). The TAPEUNITS keyword will limit the number of tape units (or drives) that the RECOVER utility will use during the RESTORE phase. In special cases, RECOVER cannot retain all of the tape volumes, so the tape volumes may be demounted and deallocated even if the PARALLEL and TAPEUNITS keywords are specified.

Avoiding damaged media

When a media error is detected, DB2 prints a message that indicates the extent of the damage. If an entire volume is bad and storage groups are being used, you must remove the bad volume first. If you don't remove the volume the RECOVER utility might re-access the damaged media.

Procedure

To avoid damaged media:

1. Use ALTER STOGROUP to remove the bad volume and add another volume. If your data sets are managed by DFSMS storage group, then you need to also remove the bad volume from the DFSMS storage group.
2. Run the RECOVER utility for all objects on that volume.

What to do next

If the RECOVER utility cannot complete because of severe errors that are caused by the damaged media, you might need to use Access Method Services (IDCAMS) with the NOSCRATCH option to delete the cluster for the table space or index. If the table space or index is defined by using STOGROUP, the RECOVER utility automatically redefines the cluster. For user-defined table spaces or indexes, you must redefine the cluster before invoking the RECOVER utility.

Related tasks:

Altering DB2 storage groups (DB2 Administration Guide)

Related reference:

ALTER STOGROUP (DB2 SQL)

Termination or restart of RECOVER

You can terminate and restart the RECOVER utility.

Termination

Terminating a RECOVER job with the **TERM UTILITY** command leaves the table space that is being recovered in RECOVER-pending status, and the index space

that is being recovered in the REBUILD-pending status. If you recover a table space to a previous point in time, its indexes are left in the REBUILD-pending status. The data or index is unavailable until the object is successfully recovered or rebuilt. If the utility fails in the LOGAPPLY, LOGCSR, or LOGUNDO phases, fix the problem that caused the job to stop and restart the job rather than terminate the job. For the rest of objects in the recover job, the RECOVER utility restores the original image copy and repeats the LOGAPPLY, LOGCSR, and LOGUNDO process again for this subset of objects. All the objects being recovered in one recover job will be available to the application at the end of the RECOVER utility, even if some of the objects do not have any active URs operating on them and therefore no rollback is needed for these objects.

Restart

You can restart RECOVER from the last commit point (RESTART(CURRENT)) or the beginning of the phase (RESTART(PHASE)). By default, DB2 uses RESTART(CURRENT).

If you attempt to recover multiple objects by using a single RECOVER statement and the utility fails in:

- The RESTORE phase: All objects in the process of being restored are placed in the RECOVER-pending or REBUILD-pending status. The status of the remaining objects is unchanged.
- The LOGAPPLY phase: All objects that are specified in the RECOVER statement are placed in the RECOVER-pending or REBUILD-pending status.

In both cases, you must identify and fix the causes of the failure before performing a current restart.

If RECOVER fails in the LOGCSR phase and you restart the utility, the utility restart behavior is RESTART(PHASE).

If RECOVER fails in the LOGUNDO phase and you restart the utility, the utility repeats the RESTORE, LOGAPPLY, LOGCSR, and LOGUNDO phases for only those objects that had active units of recovery that needed to be handled and that did not complete undo processing prior to the failure.

Related tasks:

"Restarting an online utility" on page 52

Effects of running RECOVER

The effects of running the RECOVER utility vary depending on your situation.

RECOVER without the REUSE option

When you run the RECOVER utility without the REUSE option and the data set that contains that data is DB2-managed, DB2 deletes this data set before recovery. Then, DB2 redefines a new data set with a control interval that matches the page size.

Recovering objects to a previous point in time

If you use the RECOVER utility to recover objects to a previous point in time, the counter columns in the real-time statistics tables might not be valid. Therefore, after any point-in-time recoveries, you must run the following utilities:

- REORG TABLESPACE to reestablish real-time statistic values for table spaces
- REBUILD INDEX to reestablish real-time statistic values for indexes

These actions do not apply if you recover objects to the current state. When you recover objects to the current state, the counter columns in the real-time statistics tables are still valid. DB2 does not modify them.

Cases when indexes are placed in REBUILD-pending status

When you use the RECOVER utility to recover indexes, an index might be left in REBUILD-pending status. In these rare cases, you must rebuild the index by running the REBUILD INDEX utility.

Indexes are left in REBUILD-pending status, if:

- An index with the COPY YES attribute has gone through the two-pass group buffer pool recovery pending (GRECP) or logical page list (LPL) recovery, and the RECOVER utility needs to apply the logs that are processed by the two-pass LPL or GRECP recovery
- Or the indexes are still in GRECP or LPL status, and the compensation log records are written before the physical undo logs

Sample RECOVER control statements

Use the sample control statements as models for developing your own RECOVER control statements.

Example 1: Recovering a table space

The following control statement specifies that the RECOVER utility is to recover table space DSN8D11A.DSN8S11D to the current point in time.

```
RECOVER TABLESPACE DSN8D11A.DSN8S11D
```

Example 2: Recovering a table space partition

The following control statement specifies that the RECOVER utility is to recover the second partition of table space DSN8D11A.DSN8S11D. The partition number is indicated by the DSNUM option.

```
RECOVER TABLESPACE DSN8D11A.DSN8S11D DSNUM 2
```

Example 3: Recovering a table space partition to the last image copy that was taken

The following control statement specifies that the RECOVER utility is to recover the first partition of table space DSN8D81A.DSN8S81D to the last image copy that was taken. If the last image copy that was taken is a full image copy, this full image copy is restored. If the last image copy that was taken is an incremental image copy, the most recent full image copy, along with any incremental image copies, are restored.

```
RECOVER TABLESPACE DSN8D81A.DSN8S81D DSNUM 1 TOLASTCOPY
```

Example 4: Recovering table spaces to a point in time

The following control statement specifies that the RECOVER utility is to recover the second partition of table space DSN8D11A.DSN8S11E and all of table space

DSN8D11A.DSN8S11D to the indicated quiesce point (LRSN X'00000551BE7D'). The quiesce point is indicated by the TOLOGPOINT option. The value for this option can be either an LRSN or an RBA.

```
RECOVER TABLESPACE DSN8D11A.DSN8S11E DSNUM 2
        TABLESPACE DSN8D11A.DSN8S11D
        TOLOGPOINT X'00000551BE7D'
```

Example 5: Recovering an index to the last full image copy that was taken without deleting and redefining the data sets

The following control statement specifies that the RECOVER utility is to recover index ADMF001.IADH082P to the last full image copy. The REUSE option specifies that DB2 is to logically reset and reuse DB2-managed data sets without deleting and redefining them.

```
RECOVER INDEX  ADMF001.IADH082P REUSE TOLASTFULLCOPY
```

Example 6: Recovering from concurrent copies

The RECOVER utility control statement specifies that the utility is to recover all of the objects that are included in the RCVR4_LIST. This list is defined by the preceding LISTDEF utility control statement. Because the most recent primary copy for all of these objects is a concurrent copy, CURRENTCOPYONLY option in the RECOVER statement improves the performance of restoring these concurrent copies. The LOCALSITE option indicates that RECOVER is to use image copies at the local site.

```
//STEP1    EXEC DSNUPROC,UID='JUOLU210.RCVR4',
//         UTPROC='',
//         SYSTEM='SSTR'
//UTPRINT  DD  SYSOUT=*
//SYSUT1   DD DSN=JUOLU210.RCVR4.STEP1.SYSUT1,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=JUOLU210.RCVR4.STEP1.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *

   LISTDEF RCVR4_LIST
     INCLUDE TABLESPACES TABLESPACE DBOL1002.TSOL1002
     INCLUDE TABLESPACES TABLESPACE DBOL1003.TPOL1003 PARTLEVEL 3
     INCLUDE TABLESPACES TABLESPACE DBOL1003.TPOL1003 PARTLEVEL 6
     INCLUDE TABLESPACES TABLESPACE DBOL1003.TPOL1004 PARTLEVEL 5
     INCLUDE TABLESPACES TABLESPACE DBOL1003.TPOL1004 PARTLEVEL 9
     INCLUDE INDEXSPACES INDEXSPACE DBOL1003.IPOL1051 PARTLEVEL 22
     INCLUDE INDEXSPACES INDEXSPACE DBOL1003.IPOL1061 PARTLEVEL 10
     INCLUDE INDEXSPACES INDEXSPACE DBOL1003.IXOL1062

   RECOVER LIST RCVR4_LIST
           LOCALSITE
           CURRENTCOPYONLY
 /*
```

Figure 62. Example RECOVER control statement with the CURRENTCOPYONLY option

Example 7: Recovering a list of objects on different tape devices in parallel

The control statement specifies that the RECOVER utility is to recover the list of table spaces. Full image copies and incremental image copies of the eight table spaces are stacked on four different tape volumes. The utility sorts the list of

objects and, if possible, recovers two objects at a time in parallel. This number of objects is specified by the PARALLEL option. The TAPEUNITS option specifies that up to four tape drives are to be dynamically allocated.

```
//RECOVER   EXEC DSNUPROC,SYSTEM='DSN'
//SYSIN    DD *
RECOVER PARALLEL(2) TAPEUNITS(4)
TABLESPACE DB1.TS8
TABLESPACE DB1.TS7
TABLESPACE DB1.TS6
TABLESPACE DB1.TS5
TABLESPACE DB1.TS4
TABLESPACE DB1.TS3
TABLESPACE DB1.TS2
TABLESPACE DB1.TS1
```

Figure 63. Example RECOVER control statement for a list of objects on tape

Example 8: Recovering a list of objects to a point in time

The following RECOVER control statement specifies that the RECOVER utility is to recover the specified list of objects to a common point in time (LRSN X'00000551BE7D'). The LISTDEF control statement defines which objects are to be included in the list. These objects are logically consistent after successful completion of this RECOVER job. The PARALLEL option indicates that RECOVER is to restore four objects at a time in parallel. If any of the image copies are on tape (either stacked or not stacked), RECOVER determines the number of tape drives to use to optimize the process. Any uncommitted work for all of the objects at the specified RBA are backed out by the recover operation to a point in time with consistency.

```
LISTDEF RCVRLIST INCLUDE TABLESPACE DSN8D81A.DSN8S81D
         INCLUDE INDEX DSN8810.XDEPT1
         INCLUDE INDEX DSN8810.XDEPT2
         INCLUDE INDEX DSN8810.XDEPT3
         INCLUDE TABLESPACE DSN8D81A.DSN8S81E
         INCLUDE INDEX DSN8810.XEMP1
         INCLUDE INDEX DSN8810.XEMP2
RECOVER LIST RCVRLIST TOLOGPOINT X'00000551BE7D' PARALLEL(4)
```

Example 9: Recovering an image copy

The following control statement specifies that RECOVER is to search for an image copy with an RBA or LRSN value earlier than the specified X'00000551BE7D' value to use in the RESTORE phase. Only specified dumps of the database copy pool are used for the restore of the data sets.

```
RECOVER LIST RCVRLIST RESTOREBEFORE X'00000551BE7D' PARALLEL(4)
   FROMDUMP DUMPCLASS(dcname)
```

Example 10: Recovering clone table data

The following control statement specifies that the RECOVER utility is to recover only clone table data in DBA90601.TLX9061A and recover the data to the last image copy that was taken. The REUSE option specifies that RECOVER is to logically reset and reuse DB2-managed data sets without deleting and redefining them.

```
RECOVER TABLESPACE DBA90601.TLX9061A REUSE TOLASTCOPY
          CLONE
```

Chapter 28. REORG INDEX

The REORG INDEX online utility reorganizes an index space to improve access performance and reclaim fragmented space. You can specify the degree of access to your data during reorganization, and you can collect inline statistics by using the STATISTICS keyword.

You can determine when to run REORG INDEX by using the LEAFDISTLIMIT catalog query option. If you specify the REPORTONLY option, REORG INDEX produces a report that indicates whether a REORG is recommended; in this case, a REORG is not performed. These options are not available for indexes on the directory.

To avoid the cost of running the RUNSTATS utility afterward, you can also specify the STATISTICS option to collect inline statistics when you run the REORG INDEX utility.

Output

The following list summarizes REORG INDEX output:

REORG specified
Results

REORG INDEX
Reorganizes the entire index (all parts if partitioning).

REORG INDEX PART *n*
Reorganizes PART *n* of a partitioning index or of a data-partitioned secondary index

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:
- REORG privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- DATAACCESS authority
- SYSCTRL authority
- SYSADM authority

To execute this utility on an index space in the catalog or directory, you must use a privilege set that includes one of the following authorities:
- REORG privilege for the DSNDB06 (catalog) database
- DBADM or DBCTRL authority for the DSNDB06 (catalog) database.
- Installation SYSOPR authority
- SYSCTRL authority
- SYSADM or Installation SYSADM authority
- STATS privilege for the database is required if STATISTICS keyword is specified.

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While trying to reorganize an index space in the catalog or directory, a user with authority other than installation SYSADM or installation SYSOPR might receive the following message:

```
DSNT500I "resource unavailable"
```

This message is issued when the DSNDB06.SYSTSDBA, DSNDB06.SYSTSDBU, or DSNDB06.SYSUSER catalog table space or one of the indexes is unavailable. If this problem occurs, run the REORG INDEX utility again, using an authorization ID with the installation SYSADM or installation SYSOPR authority.

An ID with installation SYSOPR authority can also execute REORG INDEX, but only on an index in the DSNDB06 database.

If either the FLASHCOPY YES or FLASHCOPY CONSISTENT option is specified, the user ID that invokes the REORG INDEX utility must have the authority to execute the DFSMSdss COPY command.

To run REORG INDEX STATISTICS REPORT YES, ensure that the privilege set includes the SELECT privilege on the catalog tables and on the tables for which statistics are to be gathered.

Execution phases of REORG INDEX

The REORG INDEX utility operates in these phases:

UTILINIT
Performs initialization and setup

UNLOAD
Unloads index space and writes keys to a sequential data set.

BUILD
Builds indexes. Updates index statistics.

LOG Processes log iteratively. Used only if you specify SHRLEVEL CHANGE.

SWITCH
Switches access between original and new copy of index space or partition. Used only if you specify SHRLEVEL REFERENCE or CHANGE.

UTILTERM
Performs cleanup. For DB2-managed data sets and either SHRLEVEL CHANGE or SHRLEVEL REFERENCE, the utility deletes the original copy of the table space or index space.

Related tasks:

Maintaining data organization (DB2 Performance)

Collecting statistics by using DB2 utilities (DB2 Performance)

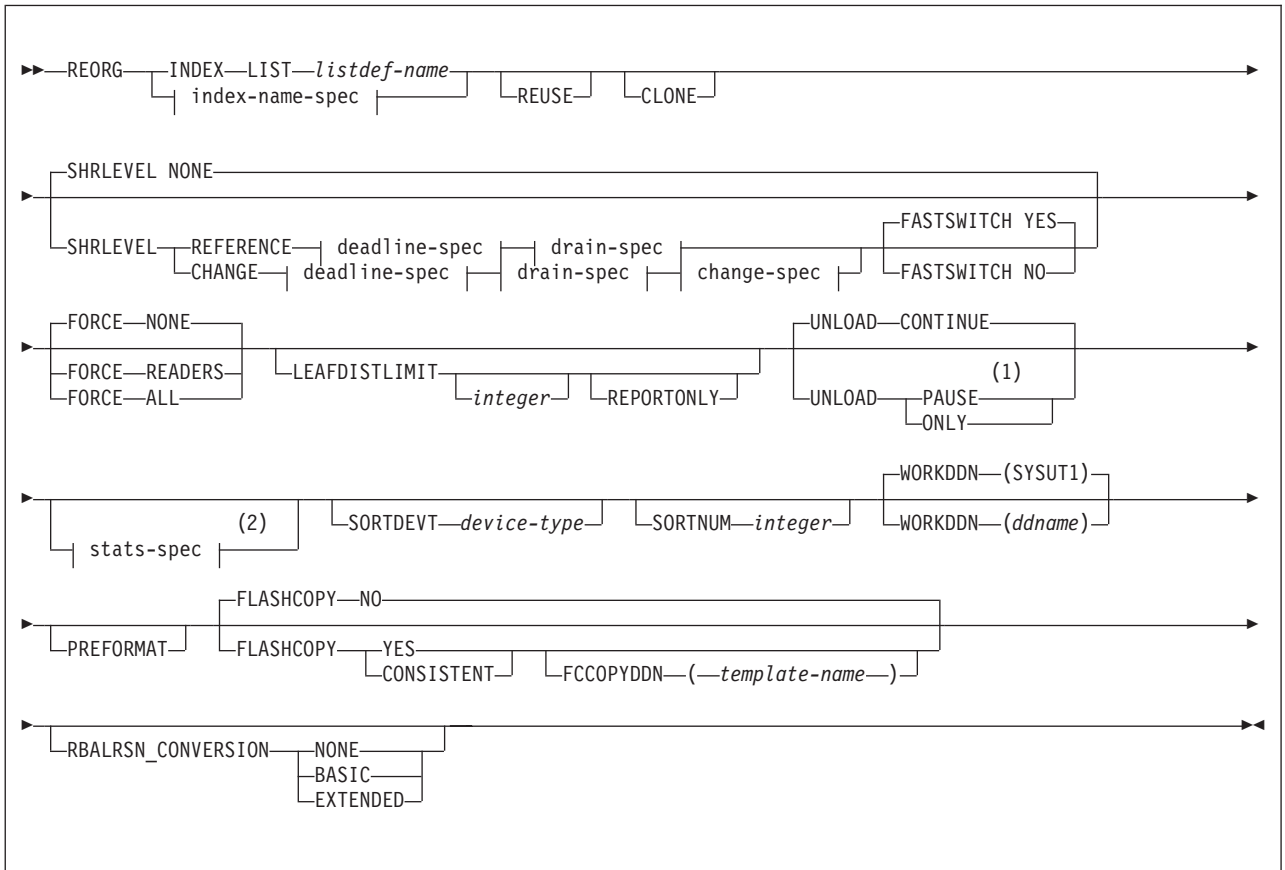
Reducing the cost of collecting statistics (DB2 Performance)

Syntax and options of the REORG INDEX control statement

The REORG INDEX utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram

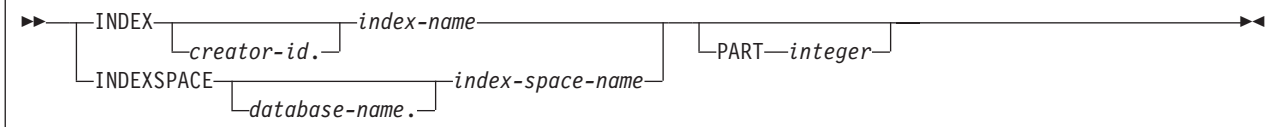


Notes:

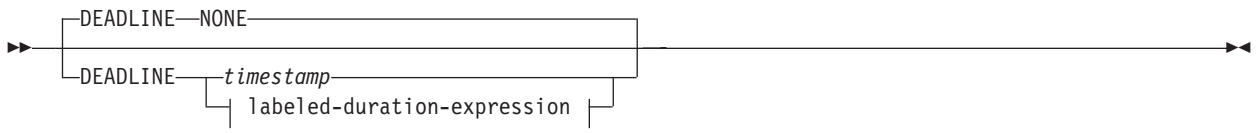
1 You cannot use UNLOAD PAUSE with the LIST option.

2 You cannot specify any options in stats-spec with the UNLOAD ONLY option.

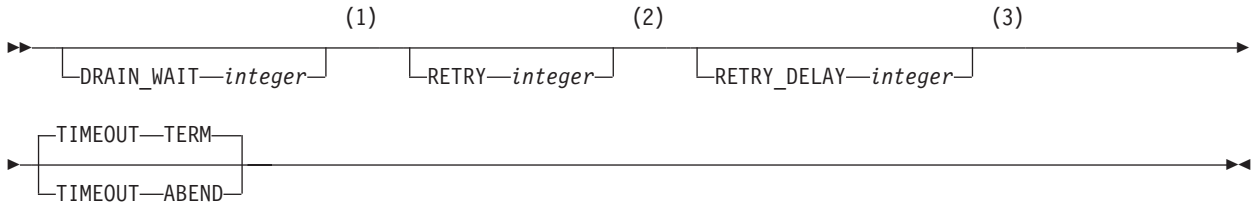
index-name-spec



deadline-spec



drain-spec



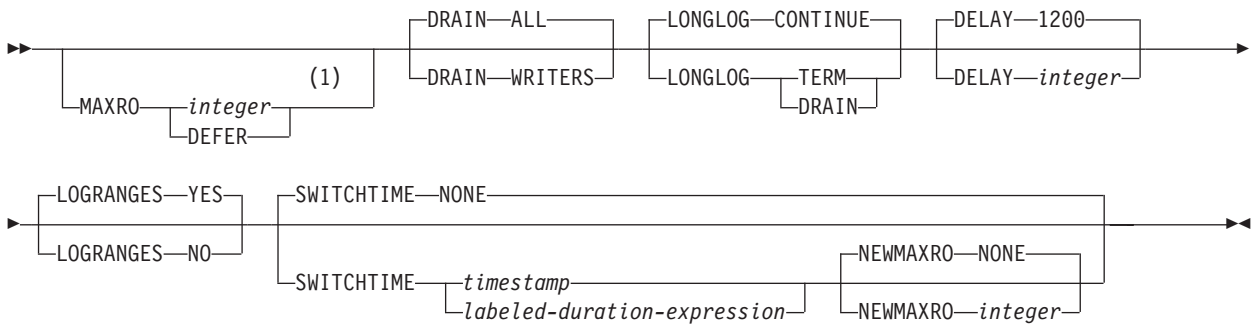
Notes:

1 The default for DRAIN_WAIT is the value of the IRLMRWT subsystem parameter.

2 The default for RETRY is the value of the UTIMOUT subsystem parameter.

3 The default for RETRY_DELAY is the smaller of the following two values: DRAIN_WAIT value × RETRY value, DRAIN_WAIT value × 10

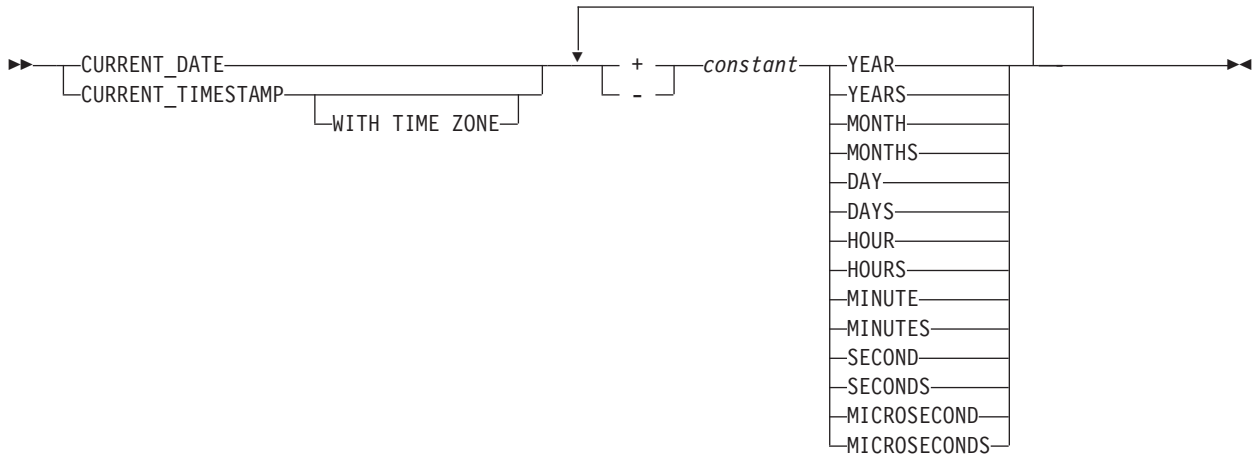
change-spec



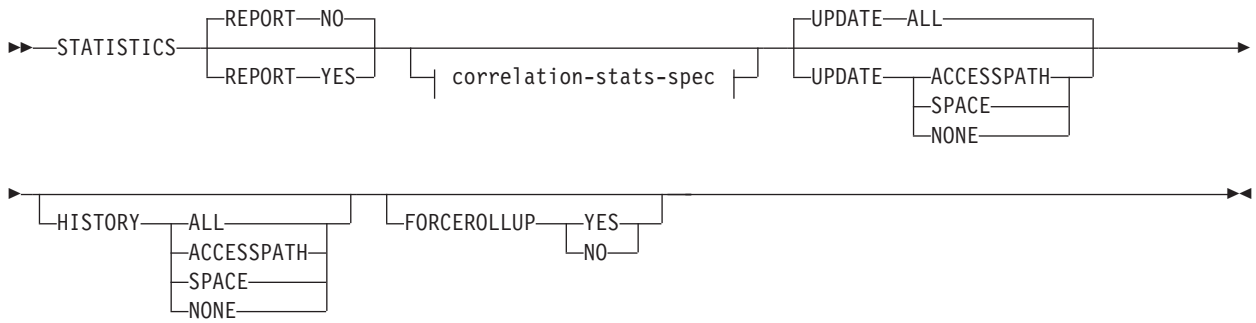
Notes:

1 The default for MAXRO is the RETRY_DELAY default value.

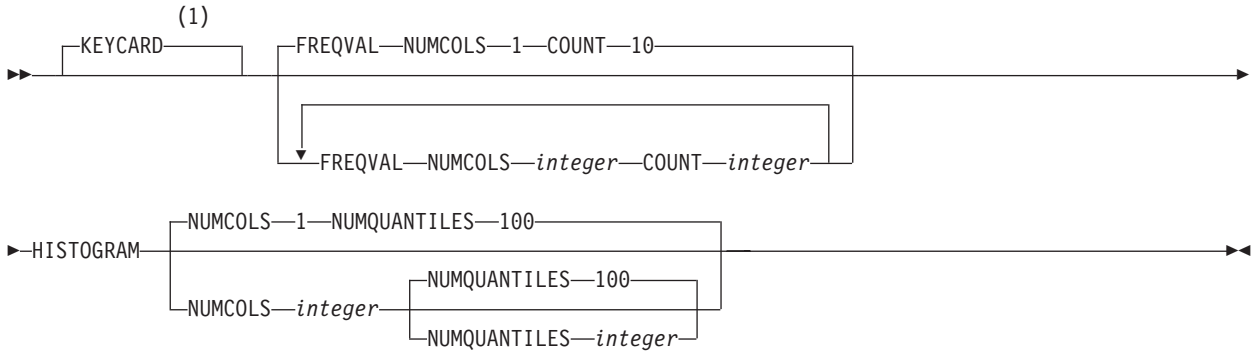
labeled-duration-expression



stats-spec



correlation-stats-spec



Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the normal execution of the RUNSTATS INDEX utility and cannot be disabled.

Option descriptions

INDEX *creator-id.index-name*
Specifies an index that is to be reorganized.

creator-id. specifies the creator of the index and is optional. If you omit the qualifier creator ID, DB2 uses the user identifier for the utility job. *index-name* is the qualified name of the index to copy. For an index, you can specify either an index name or an index space name. Enclose the index name in quotation marks if the name contains a blank.

INDEXSPACE *database-name.index-space-name*
Specifies the qualified name of the index space that is obtained from the SYSIBM.SYSINDEXES table.

database-name specifies the name of the database that is associated with the index and is optional.

The default value is **DSNDB04**.

index-space-name specifies the qualified name of the index space that is to be reorganized; the name is obtained from the SYSIBM.SYSINDEXES table.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. The INDEX keyword is required to differentiate this REORG INDEX LIST from REORG TABLESPACE LIST. The utility allows one LIST keyword for each control statement of REORG INDEX. The list must not contain any table spaces. REORG INDEX is invoked once for each item in the list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

Do not specify STATISTICS INDEX *index-name* with REORG INDEX LIST. If you want to collect inline statistics for a list of indexes, just specify STATISTICS.

You cannot specify DSNUM and PART with LIST on any utility.

The partitions or partition ranges can be specified in a list.

PART *integer*

Identifies a partition that is to be reorganized. You can reorganize a single partition of a partitioning index. You cannot specify PART with LIST. *integer* is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the partitioning index. The maximum value is 4096.

integer designates a single partition.

If you omit the PART keyword, the entire index is reorganized.

REUSE

When used with SHRLEVEL NONE, specifies that REORG is to logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE and SHRLEVEL NONE, DB2 deletes and redefines DB2-managed data sets to reset them.

If a data set has multiple extents and you use the REUSE parameter, the extents are not released.

If you specify SHRLEVEL REFERENCE or CHANGE with REUSE, REUSE does not apply

CLONE

Indicates that REORG INDEX is to reorganize only the specified index spaces and indexes that are defined on clone tables. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

SHRLEVEL

Specifies the method for performing the reorganization. The parameter following SHRLEVEL indicates the type of access that is to be allowed during the RELOAD phase of REORG.

NONE

Specifies that reorganization is to operate by unloading from the area that is being reorganized (while applications can read but cannot write to the area), building into that area (while applications have no access), and then allowing read-write access again.

If you specify NONE (explicitly or by default), you cannot specify the following parameters:

- MAXRO
- LONGLOG
- DELAY
- DEADLINE
- DRAIN_WAIT
- RETRY
- RETRY_DELAY

REFERENCE

Specifies that reorganization is to operate as follows:

- Unload from the area that is being reorganized while applications can read but cannot write to the area.
- Build into a shadow copy of that area while applications can read but cannot write to the original copy.

- Switch the future access of the applications from the original copy to the shadow copy by exchanging the names of the data sets, and then allowing read-write access again.

If you specify REFERENCE, you cannot specify the following parameters:

- UNLOAD (Reorganization with REFERENCE always performs UNLOAD CONTINUE.)
- MAXRO
- LONGLOG
- DELAY

CHANGE

Specifies that reorganization is to operate as follows:

- Unload from the area that is being reorganized while applications can read and write to the area.
- Build into a shadow copy of that area while applications can read and write to the original copy.
- Apply the log of the original copy to the shadow copy while applications can read and usually write to the original copy.
- Switch the future access of the applications from the original copy to the shadow copy by exchanging the names of the data sets, and then allowing read-write access again.

If you specify CHANGE, you cannot specify the UNLOAD parameter. Reorganization with CHANGE always performs UNLOAD CONTINUE.

SHRLEVEL CHANGE cannot be specified if the table space has the NOT LOGGED attribute.

DEADLINE

Specifies the deadline for the SWITCH phase to begin. If DB2 estimates that the SWITCH phase does not begin by the deadline, DB2 issues the messages that the DISPLAY UTILITY command issues and then terminates reorganization.

The final result and all the timestamp calculation of DEADLINE will be in TIMESTAMP(6).

NONE

Specifies that no deadline exists by which the switch phase of log processing must begin.

timestamp

Specifies the deadline for the switch phase of log processing to begin. This deadline must not have already occurred when REORG is executed.

labeled-duration-expression

Calculates the deadline for the switch phase of log processing to begin. The calculation is based on either CURRENT TIMESTAMP or CURRENT DATE. You can add or subtract one or more *constant* values to specify the deadline. This deadline must not have already occurred when REORG is executed. CURRENT TIMESTAMP and CURRENT DATE are evaluated once, when the REORG statement is first processed. If a list of objects is specified, the same value will be in effect for all objects in the list.

CURRENT_DATE

Specifies that the deadline is to be calculated based on the CURRENT DATE.

CURRENT_TIMESTAMP
Specifies that the deadline is to be calculated based on the CURRENT TIMESTAMP.

WITH TIME ZONE
Specifies that the CURRENT TIMESTAMP is compared with the time zone column. The timestamp precision of the special register CURRENT TIMESTAMP should be the same as the column timestamp precision. Otherwise the default timestamp precision is used. The time zone of CURRENT TIMESTAMP is the value of special register CURRENT TIMEZONE. The comparison is done by comparing the UTC portion of the timestamp.

constant
Indicates a unit of time and is followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS. The singular form of these words is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, MICROSECOND.

If REORG SHRLEVEL REFERENCE or SHRLEVEL CHANGE terminates because of a DEADLINE specification, DB2 issues message DSNU374I with reason code 2 but does not set a restrictive status.

DRAIN_WAIT *integer*
Specifies the number of seconds that the utility waits when draining for SQL statements (inserts, updates, deletes, and selects). The specified time is the aggregate time for all partitions of the index that is to be reorganized. This value overrides the values specified by IRLMRWT and UTIMOUT, for these SQL statements only. For operations like commands, the IRLMRWT and UTIMOUT values are used. Valid values for *integer* are from 0 to 1800. If the keyword is omitted or if a value of 0 is specified, the utility uses the value of the lock timeout system parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of retries that REORG is to attempt. Valid values for *integer* are from 0 to 255.

Specifying RETRY can lead to increased processing costs and can result in multiple or extended periods of read-only access.

The default value is the value of the **UTIMOUT** subsystem parameter.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between retries. Valid values for *integer* are from 1 to 1800.

If you do not specify RETRY_DELAY, REORG INDEX uses the smaller of the following two values:

- DRAIN_WAIT value × RETRY value
- DRAIN_WAIT value × 10

MAXRO *integer*
Specifies the maximum amount of time for the last iteration of log processing. During that iteration, applications have read-only access.

The actual execution time of the last iteration might exceed the specified MAXRO value.

The **ALTER UTILITY** command can change the value of MAXRO.

The default value is the **RETRY_DELAY** default value.

integer
integer is the number of seconds. Specifying a small positive value reduces the length of the period of read-only access, but it might increase the elapsed time for REORG to complete. If you specify a huge positive value, the second iteration of log processing is probably the last iteration.

The default value is **300** seconds.

DEFER
Specifies that the iterations of log processing with read-write access can continue indefinitely. REORG never begins the final iteration with read-only access, unless you change the MAXRO value by using the **ALTER UTILITY** command.

If you specify DEFER, you should also specify LONGLOG CONTINUE.

If you specify DEFER, and DB2 determines that the actual time for an iteration and the estimated time for the next iteration are both less than 5 seconds, DB2 adds a 5-second pause to the next iteration. This pause reduces consumption of processor time. The first time this situation occurs for a given execution of REORG, DB2 sends message DSNU362I to the console. The message states that the number of log records that must be processed is small and that the pause occurs. To change the MAXRO value and thus cause REORG to finish, execute the **ALTER UTILITY** command. DB2 adds the pause whenever the situation occurs; however, DB2 sends the message only if 30 minutes have elapsed since the last message was sent for a given execution of REORG.

DRAIN
Specifies drain behavior at the end of the log phase after the MAXRO threshold is reached and when the last iteration of the log is to be applied.

WRITERS
Specifies that DB2 drains only the writers during the log phase after the MAXRO threshold is reached and then issues DRAIN ALL on entering the switch phase.

ALL
Specifies the current default action, in which DB2 is to drain all readers and writers during the log phase, after the MAXRO threshold is reached.

Consider specifying DRAIN ALL if the following conditions are both true:

- SQL update activity is high during the log phase.
- The default behavior results in a large number of -911 SQL error messages.

LONGLOG
Specifies the action that DB2 is to perform, after sending a message to the console, if the number of records that the next iteration of log process is to process is not sufficiently lower than the number that the previous iterations processed. This situation means that REORG INDEX is not reading the application log quickly enough to keep pace with the writing of the application log.

CONTINUE
Specifies that until the time on the JOB statement expires, DB2 is to continue performing reorganization, including iterations of log processing, if the estimated time to perform an iteration exceeds the time that is specified with MAXRO.

A value of DEFER for MAXRO and a value of CONTINUE for LONGLOG together mean that REORG INDEX is to continue allowing access to the original copy of the area that is being reorganized and does not switch to the shadow copy. The user can execute the **ALTER UTILITY** command with a large value for MAXRO when the switching is wanted.

TERM
Specifies that DB2 is to terminate reorganization after the delay specified by the DELAY parameter.

DRAIN
Specifies that DB2 is to drain the write claim class after the delay that is specified by the DELAY parameter. This action forces the final iteration of log processing to occur.

DELAY *integer*
Specifies the minimum interval between the time that REORG sends the LONGLOG message to the console and the time REORG that performs the action that is specified by the LONGLOG parameter.

integer is the number of seconds.

The default value is **1200**.

TIMEOUT
Specifies the action that is to be taken if the REORG INDEX utility gets a timeout condition while trying to drain objects in either the log or switch phases.

TERM
Indicates that DB2 is to behave as follows if you specify the TERM option and a time out condition occurs:

1. DB2 issues an implicit **TERM UTILITY** command, causing the utility to end with a return code 8.
2. DB2 issues the DSNU590I and DSNU170I messages.
3. DB2 leaves the objects in a RW state.

ABEND
Indicates that if a timeout condition occurs, DB2 is to leave the objects in a UTRO or UTUT state.

LOGRANGES
Specifies whether REORG is to use SYSLGRNX information for the LOG phase.

YES
REORG uses SYSLGRNX information for the LOG phase whenever possible. This option is the default behavior.

NO REORG does not use SYSLGRNX information for the LOG phase. This option can cause REORG to run much longer. In a data sharing environment this option can result in the merging of all logs from all members. This option is feasible when there is a known integrity issue with SYSLGRNX entries and performance problems in accessing SYSLGRNX for log read determination.

SWITCHTIME
Specifies the time for the final log iteration of the LOG phase to begin. The final result and all of the time stamp calculations of SWITCHTIME are in TIMESTAMP(6). This keyword can be specified with the MAXRO keyword. If MAXRO DEFER is not specified, REORG enters the final log iteration of the LOG phase before the specified SWITCHTIME value if the specified or

defaulted MAXRO criteria is met. When MAXRO DEFER is specified, REORG does not attempt to enterto the final log iteration until the specified SWITCHTIME is met or affected by an external ALTER UTILITY command in the changing of its MAXRO value.

NONE
Does not specify a time for the final log iteration of the LOG phase. This option is the default behavior.

timestamp
Specifies the time that the final log iteration of the LOG phase is to begin. This time must not have already occurred when REORG is run.

labeled-duration-expression
Calculates the time for the final log iteration of LOG phase is to begin. The calculation is based on either CURRENT TIMESTAMP or CURRENT DATE. You can add or subtract one or more constant values to specify the switch time. This switch time must not have already occurred when REORG is run. CURRENT TIMESTAMP and CURRENT DATE are evaluated once, when the REORG statement is first processed. If a list of objects is specified, the same value is in effect for all objects in the list.

CURRENT_DATE
Specifies that the deadline is to be calculated based on the CURRENT DATE.

CURRENT_TIMESTAMP
Specifies that the deadline is to be calculated based on the CURRENT TIMESTAMP.

WITH TIME ZONE
Specifies that the CURRENT TIMESTAMP is compared with the time zone column. The time stamp precision of the special register CURRENT TIMESTAMP should be the same as the column time stamp precision. Otherwise, the default time stamp precision is used. The time zone of CURRENT TIMESTAMP is the value of special register CURRENT TIMEZONE. The comparison is done by comparing the Coordinated Universal Time portion of the time stamp.

constant
Indicates a unit of time and is followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS. The singular form of these words is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, MICROSECOND.

NEWMAXRO
Specifies the maximum amount of time for the last log iteration after SWITCHTIME is met. The SWITCHTIME keyword must also be specified. This value overrides the existing MAXRO parameter that is specified. The default is NONE.

NONE
Specifies that when the specified SWITCHTIME is met, REORG proceeds to the last log iteration without taking log processing time in to consideration. Specifying NONE results in REORG entering the last log iteration almost immediately at or after the specified SWITCHTIME. This option is the default.

integer
integer is the number of seconds. Specifying a small positive value reduces

the length of the period of read-only access, but it might increase the elapsed time for REORG to complete. Specifying a large positive value probably ensures that REORG will enter the last log iteration almost immediately at or after the specified SWITCHTIME.

FORCE
Specifies the action to be taken when the utility is draining the table space.

When REORG FORCE is canceling the threads, it performs a soft cancel similar to the cancel that the CANCEL THREAD does.

NONE
Specifies that no action is taken when REORG performs drain. The REORG utility waits for the claimers to commit. The utility will timeout or restart when the drain fails, as determined by existing conditions.

READERS
Specifies that read claimers are canceled when REORG is requesting a drain all on the last RETRY processing.

ALL
specifies that both read and write claimers are canceled when REORG is requesting a drain all or drain writers on the last RETRY processing.

FASTSWITCH
Specifies which switch methodology is to be used for a reorganization.

When FASTSWITCH is specified with SHRLEVEL CHANGE or SHRLEVEL REFERENCE, the UTILITY_OBJECT_CONVERSION subsystem parameter setting NONE, BASIC, or EXTENDED is accepted.

YES
Enables the SWITCH phase to use the FASTSWITCH methodology. This option is not allowed for the catalog (DSNDB06) or directory (DSNDB01).

NO Causes the SWITCH phase to use IDCAMS RENAME.

LEAFDISTLIMIT *integer*

The LEAFDISTLIMIT option is deprecated, and the alternative is running DSNACCOX.Specifies that the value for *integer* is to be compared to the LEAFDIST value for the specified partitions of the specified index in SYSIBM.SYSINDEXPART. If any LEAFDIST value exceeds the specified LEAFDISTLIMIT value, REORG is performed or, if you specify REPORTONLY, recommended.

The default value is **200**.

Because a node ID index , auxiliary index, hash index, or XML index has a LEAFDIST value of -2, REORG is not performed for any of those indexes when LEAFDISTLIMIT is specified.

REPORTONLY

The REPORTONLY option is deprecated, and the alternative is running DSNACCOX.Specifies that REORG is only to be recommended, not performed. REORG produces a report with one of the following return codes:
1 No limit met; no REORG performed or recommended.
2 REORG performed or recommended.

UNLOAD
Specifies whether the utility job is to continue processing or terminate after the data is unloaded.

CONTINUE
Specifies that, after the data has been unloaded, the utility is to continue processing.

PAUSE

The UNLOAD PAUSE option has been deprecated. If you need to stop the utility after the keys are unloaded, use DIAGNOSE in combination with the REORG utility to stop the process (pause).Specifies that, after the data has been unloaded, processing is to end. The utility stops and the RELOAD status is stored in SYSIBM.SYSUTIL so that processing can be restarted with RELOAD RESTART(PHASE).

This option is useful if you want to redefine data sets during reorganization. For example, with a user-defined data set, you can:
- Run REORG with the UNLOAD PAUSE option.
- Redefine the data set using Access Method Services.
- Restart REORG by resubmitting the previous job and specifying RESTART(PHASE).

If no records are unloaded during an UNLOAD PAUSE, when REORG is restarted, the RELOAD and BUILD phases are bypassed.

You cannot use UNLOAD PAUSE if you specify the LIST option.

ONLY

The UNLOAD ONLY option has been deprecated. If you need to unload the keys, use DIAGNOSE in combination with the REORG utility to stop the process after the keys are unloaded, and TERM UTIL to terminate the utility.Specifies that, after the data has been unloaded, the utility job ends and the status in SYSIBM.SYSUTIL that corresponds to this utility ID is removed.

STATISTICS
Specifies that statistics for the index are to be collected; the statistics are either reported or stored in the DB2 catalog. You cannot collect inline statistics for indexes on the catalog and directory tables.

Restrictions:

- If you specify STATISTICS for encrypted data, DB2 might not provide useful information on this data.
- You cannot specify STATISTICS for clone objects.

If pending definition changes are materialized during REORG INDEX with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, index statistics are collected and updated in the DB2 catalog by default.

If the STATISTICS keyword was not specified in the REORG INDEX with SHRLEVEL REFERENCE or CHANGE statement when pending definition changes are materialized, the following keywords are run by default: STATISTICS UPDATE ALL HISTORY ALL. If you also specify the STATISTICS keyword in the REORG INDEX with the SHRLEVEL REFERENCE or SHRLEVEL CHANGE statement when pending definition changes are materialized, the options specified overwrite the default options.

Recommendation: Some partition statistics can become obsolete due to the materialization of pending definition changes. The partition statistics that can become obsolete are COLGROUP statistics, statistics for key column values in

indexes, HISTOGRAM statistics, frequency statistics with NUMCOLS > 1, and statistics for extended indexes where applicable. Run the RUNSTATS utility to collect the partition statistics again.

REPORT
Indicates whether a set of messages is to be generated to report the collected statistics.

NO Indicates that the set of messages is not to be sent as output to SYSPRINT.

YES
Indicates that the set of messages is to be sent as output to SYSPRINT. The generated messages are dependent on the combination of keywords (such as TABLESPACE, INDEX, TABLE, and COLUMN) that are specified with the RUNSTATS utility. However, these messages are **not** dependent on the specification of the UPDATE option. REPORT YES always generates a report of SPACE and ACCESSPATH statistics.

KEYCARD
The KEYCARD option is deprecated in the REORG INDEX control statement and no longer needs to be specified to collect cardinality statistics on the values in the key columns of an index.

When the STATISTICS option is specified, the REORG INDEX utility now always collects all of the distinct values in all of the 1 to *n* key column combinations for the indexes being rebuilt.*n* is the number of columns in the index. With the deprecation of KEYCARD, this functionality cannot be disabled.

The REORG INDEX utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when STATISTICS is specified.

FREQVAL
Specifies that frequent value statistics are to be collected. If you specify FREQVAL, you must also specify NUMCOLS and COUNT.

NUMCOLS
Indicates the number of key columns to concatenate together when you collect frequent values from the specified index. Specifying 3 means that DB2 is to collect frequent values on the concatenation of the first three key columns.

The default value is **1**, which means DB2 is to collect frequent values on the first key column of the index.

COUNT
Indicates the number of frequent values that are to be collected. Specifying 15 means that DB2 is to collect 15 frequent values from the specified key columns.

The default value is **10**.

HISTOGRAM
Indicates that histogram statistics are requested for the specified index.

NUMCOLS
The number of key columns that are to be concatenated when collecting histogram statistics from the specified index.

NUMQUANTILES
The integer values that follows NUMQUANTILES indicates the number quantiles are requested. The integer value must be greater than or equal to 1.

Histogram statistics can be collected only on keys with the same order if the specified key columns for histogram statistics are of mixed order, a DSNU633I warning message is issued.

Histogram statistics that you collect through REORG INDEX are not the same as histogram statistics that you collect through RUNSTATS. Histogram statistics that you collect with REORG INDEX are only rough estimates. To obtain more exact statistics, use RUNSTATS.

Related information:

Histogram statistics (DB2 Performance)

DSNU633I (DB2 Messages)

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by the external sort program. For *device-type*, specify any disk device that is valid on the DYNALLOC parameter of the SORT or OPTION options for the sort program.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated when collecting statistics for a data-partitioned secondary index. If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

integer is the number of temporary data sets that can range from 2 to 255.

REORG INDEX does not sort index keys. Only one sort can be performed, and that is if inline statistics are being collected for a DPSI.

Important: The SORTNUM keyword will not be considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

UPDATE
Indicates whether the collected statistics are to be inserted into the catalog tables. UPDATE also allows you to select statistics that are used for access path selection or statistics that are used by database administrators.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that only the catalog table columns that provide statistics that are used for access path selection are to be updated.

SPACE
Indicates that only the catalog table columns that provide statistics to help the database administrator to assess the status of a particular table space or index are to be updated.

NONE
Indicates that catalog tables are not to be updated with the collected statistics. This option is valid only when REPORT YES is specified.

HISTORY
Indicates that all catalog table inserts or updates to the catalog history tables are to be recorded.

The default is supplied by the specified value in STATISTICS HISTORY on panel DSNTIP6.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that only the catalog history table columns that provide statistics used for access path selection are to be updated.

SPACE
Indicates that only space-related catalog statistics are to be updated in catalog history tables.

NONE
Indicates that catalog history tables are not to be updated with the collected statistics.

FORCEROLLUP
Specifies whether aggregation or rollup of statistics are to take place when RUNSTATS is executed even when some parts are empty. This option enables the optimizer to select the best access path.

YES
Indicates that forced aggregation or rollup processing is to be done, even though some parts might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all parts.

If data is not available for all parts and if the installation value for STATISTICS ROLLUP on panel DSNTIP6 is set to NO, DSNU623I message is issued.

WORKDDN(*ddname***)**
ddname specifies the DD statement for the unload data set.

ddname
Is the DD name of the temporary work file for build input.

The default value is **SYSUT1**.

The WORKDDN keyword specifies either a DD name or a TEMPLATE name from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses DD name.

Even though WORKDDN is an optional keyword, a DD statement for the unload output data set is required in the JCL. If you do not specify WORKDDN, or if you specify it without *ddname*, the JCL must have a DD statement with the name SYSUT1. If *ddname* is given, you must provide a DD statement or TEMPLATE that matches the DD name.

PREFORMAT
Specifies that the remaining pages are to be preformatted up to the high-allocated RBA in the index space. The preformatting occurs after the index is built.

PREFORMAT can operate on an entire index space, or on a partition of a partitioned index space.

PREFORMAT is ignored if you specify UNLOAD ONLY.

FLASHCOPY
Specifies whether FlashCopy technology is used to create a copy of the object. Valid values are YES, NO, or CONSISTENT. When FlashCopy is used, a separate data set is created for each partition or piece of the object.

The FlashCopy specifications on the utility control statement override any specifications for FlashCopy that are defined by using the DB2 subsystem parameters. If the FlashCopy subsystem parameters specify the use of FlashCopy as the default behavior of this utility, the FLASHCOPY option can be omitted from the utility control statement.

Important: If the input data set is less than one cylinder, FlashCopy technology might not be used for copying the objects regardless of the FLASHCOPY settings. The copy is performed by IDCAMS if FlashCopy is not used.

NO Specifies that no FlashCopy is made. NO is the default value for FLASHCOPY.

YES
Specifies that FlashCopy technology is used to copy the object.

Specify YES only if the DB2 data sets are on FlashCopy Version 2 disk volumes.

Important: Under the following circumstances, the REORG INDEX utility might not use FlashCopy even though YES is specified:

- FlashCopy Version 2 disk volumes are not available
- The source tracks are already the target of a FlashCopy operation
- The target tracks are the source of a FlashCopy operation
- The maximum number of relationships for the copy is exceeded

In the event that FlashCopy is not used, the REORG INDEX utility uses traditional I/O methods to copy the object, which can result in longer than expected execution time.

If SHRLEVEL REFERENCE or SHRLEVEL CHANGE is specified when the copy operation is forced to use traditional I/O methods, an even longer outage might occur, because the FlashCopy image copies are created during the SWITCH phase of utility execution.

CONSISTENT
Specifies that FlashCopy technology is used to copy the object. Because the copies created by the REORG INDEX utility are already consistent, the utility treats a specification of CONSISTENT the same as a specification of YES.

RBALRSN_CONVERSION
Specifies the RBA or LRSN format of the target object after the completion of the REORG utility. If the keyword is not specified, the conversion specified in the UTILITY_OBJECT_CONVERSION subsystem parameter is accepted.

NONE
Specifies that no conversion is performed.

The utility fails if RBALRSN_CONVERSION NONE is specified on a table space that is in basic 6-byte format and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

BASIC
Specifies that if an object is found in extended 10-byte format, it is converted to 6-byte basic format.

The utility fails if RBALRSN_CONVERSION BASIC is specified and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

EXTENDED
Specifies that if an object is found in basic 6-byte format, it is converted to 10-byte extended format.

If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to BASIC or EXTENDED, RBALRSN_CONVERSION defaults to the UTILITY_OBJECT_CONVERSION value. If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to NOBASIC, RBALRSN_CONVERSION defaults to EXTENDED.

If a CLONE relationship exists, the page set conversion cannot be performed. For clone relationships, you must drop the clone table, convert the base table to extended 10-byte format, and then re-create the clone table.

FCCOPYDDN
Specifies the template to be used to create the FlashCopy image copy data set names. If a value is not specified for FCCOPYDDN on the REORG INDEX control statement when FlashCopy is used, the value specified on the FCCOPYDDN subsystem parameter determines the template to be used.

(*template-name***)**
The data set names for the FlashCopy image copy are allocated according to the template specification. For table space or index space level FlashCopy image copies, because a data set is allocated for each partition or piece, ensure that the data set naming convention in the template specification is unique enough. Use the &DSNUM variable, which resolves to a partition number or piece number at execution time.

Related tasks:

"Improving LOAD performance" on page 334

Related reference:

Chapter 35, "TEMPLATE," on page 789

Chapter 19, "LISTDEF," on page 221

DB2 Sort

Related information:

DFSORT Application Programming Guide

Before running REORG INDEX

Certain activities might be required before you run the REORG INDEX utility, depending on your situation.

Region size

The recommended minimum region size is 4096 KB.

Restart-pending status and SHRLEVEL CHANGE

If you specify SHRLEVEL CHANGE, REORG drains the write claim class near the end of REORG processing. In a data sharing environment, if a data sharing member fails and that member has restart-pending status for a target page set, the drain can fail. You must postpone running REORG with SHRLEVEL CHANGE until all restart-pending statuses have been removed. You can use the DISPLAY GROUP command to determine whether a member's status is FAILED. You can use the DISPLAY DATABASE command with the LOCKS option to determine if locks are held.

Data sharing considerations for REORG

You must not execute REORG on an object if another DB2 subsystem holds retained locks on the object or has long-running noncommitting applications that use the object. You can use the DISPLAY GROUP command to determine whether a member's status is "FAILED." You can use the DISPLAY DATABASE command with the LOCKS option to determine if locks are held.

Fallback recovery considerations

Successful REORG INDEX processing inserts a SYSCOPY row with ICTYPE='W' for an index that was defined with COPY YES. REORG also places a reorganized index in informational COPY-pending status. You should take a full image copy of the index after the REORG job completes to create a valid point of recovery.

RECOVER-pending and REBUILD-pending status

You cannot reorganize an index if any partition of the index is in the RECOVER-pending status or in the REBUILD-pending status. Similarly, you cannot reorganize a single index partition if it is in the RECOVER-pending status or in the REBUILD-pending status.

The RECOVER-pending restrictive state is:

RECP The index space or partition is in a RECOVER-pending status. A single logical partition in RECP does not restrict access to other logical partitions that are not in RECP. You can reset RECP by recovering only the single logical partition.

The REBUILD-pending restrictive states are:

RBDP REBUILD-pending status is set on a physical or logical index partition. The individual physical or logical partition is inaccessible; you must rebuild the object using the REBUILD INDEX utility.

PSRBD
Page set REBUILD-pending (PSRBD) is set for nonpartitioning indexes. The entire index space is inaccessible; you must rebuild the object by using the REBUILD INDEX utility.

RBDP*
A REBUILD-pending status is set only on logical partitions of

nonpartitioning indexes. The entire index is inaccessible, but it is made available again when you rebuild the affected partitions by using the REBUILD INDEX utility.

CHECK-pending status

You cannot reorganize an index when the data is in the CHECK-pending status.

Running REORG INDEX when the index has a VARBINARY column

If you run REORG INDEX against an index with the following characteristics, REORG INDEX fails:

- The index was created on a VARBINARY column or a column with a distinct type that is based on a VARBINARY data type.
- The index column has the DESC attribute.

To fix the problem, alter the column data type to BINARY, and then rebuild the index.

Related reference:

"RECOVER-pending status" on page 1110

"REBUILD-pending status" on page 1109

Chapter 12, "CHECK DATA," on page 79

Related information:

Data sets that REORG INDEX uses

The REORG INDEX utility uses a number of data sets during its operation.

The following table lists the data sets that REORG uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 71. Data sets that REORG INDEX uses

Data set	Description	Required?
SYSIN	Input data set that contain the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
STPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when statistics are collected on at least one data-partitioned secondary index.	No[1]
Work data set	A temporary data set for unload output and build input. Specify the DD or template name with the WORKDDN option of the utility control statement. The default DD name is SYSUT1.	Yes
Sort work data sets	Temporary data sets for sort input and output when collecting inline statistics on at least one data-partitioned secondary index. The DD names have the form ST01WK*nn*.	No[2,3,4]

Table 71. Data sets that REORG INDEX uses (continued)

Data set	Description	Required?
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes
FlashCopy image copy data sets	For copies of the entire index space, a separate VSAM data set for each partition or piece that is contained in the index space. For partition-level or piece-level copies, a VSAM data set for each partition or piece that is being copied.	No[5]

Note:
1. STPRIN01 is required if statistics are being collected on at least one data-partitioned secondary index, but REORG INDEX dynamically allocates the STPRIN01 data set if UTPRINT is allocated to SYSOUT.
2. Required when collecting inline statistics on at least one data-partitioned secondary index.
3. If the DYNALLOC parm of the SORT program is not turned on, you need to allocate the data set. Otherwise, the sort program dynamically allocates the temporary data set.
4. It is recommended that you use dynamic allocation by specifying SORTDEVT in the utility statement because dynamic allocation reduces the maintenance required of the utility job JCL.
5. Required if you specify the FLASHCOPY YES

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Index Object to be reorganized.

Calculating the size of the work data sets

When reorganizing an index space, you need a non-DB2 sequential work data set. That data set is identified by the DD statement that is named in the WORKDDN option. During the UNLOAD phase, the index keys and the data pointers are unloaded to the work data set. This data set is used to build the index. It is required only during the execution of REORG.

Use the following formula to calculate the approximate size (in bytes) of the WORKDDN data set SYSUT1:

```
size = number of keys x (key length + 8)
```

Calculating the size of the sort work data sets

To calculate the approximate size (in bytes) of the ST01WK*nn* data set, use the following formula:

2 ×(*maximum record length* × *numcols* × (*count* + 2) × number of indexes)

The variables in the preceding formula have the following values:

maximum record length
Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

numcols
Number of key columns to concatenate when you collect frequent values from the specified index.

count Number of frequent values that DB2 is to collect.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. When you allocate sort work data sets on disk, the recommended amount of space to allow provides at least 1.2 times the amount of data that is to be sorted.

Changing data set definitions

If the index space is defined by storage groups, space allocation is handled by DB2 and data set definitions cannot be altered during the reorganization process. DB2 deletes and redefines the necessary data sets to reorganize the object.

For REORG with SHRLEVEL REFERENCE or CHANGE, you can use the ALTER STOGROUP command to change the characteristics of a DB2-managed data set. You can effectively change the characteristics of a user-managed data set by specifying the new characteristics when creating the shadow data set. In particular, placing the original and shadow data sets on different disk volumes might reduce contention and thus improve the performance of REORG and the performance of applications during REORG execution.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Shadow data sets

When you execute the REORG INDEX utility with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, the utility uses shadow data sets.

For user-managed data sets, you must preallocate the shadow data sets before you execute REORG INDEX with SHRLEVEL REFERENCE or SHRLEVEL CHANGE. If an index or partitioned index resides in DB2-managed data sets and shadow data sets do not already exist when you execute REORG INDEX, DB2 creates the shadow data sets. At the end of REORG processing, the DB2-managed shadow data sets are deleted. You can create the shadows ahead of time for DB2-managed data sets.

Shadow data set names

Each shadow data set must have the following name:

catname.DSNDB*x*.*dbname*.*psname*.*y*000*z*.*Lnnn*

In the preceding name, the variables have the following meanings:

variable
meaning

catname
The VSAM catalog name or alias

x C or D

dbname
Database name

psname
Table space name or index name

y I or J

z 1 or 2

Lnnn Partition identifier. Use one of the following values:

- A001 through A999 for partitions 1 through 999
- B000 through B999 for partitions 1000 through 1999
- C000 through C999 for partitions 2000 through 2999
- D000 through D999 for partitions 3000 through 3999
- E000 through E996 for partitions 4000 through 4096

GUPI To determine the names of existing data sets, execute one of the following queries against the SYSTABLEPART or SYSINDEXPART catalog tables:

```
SELECT DBNAME, TSNAME, IPREFIX
   FROM SYSIBM.SYSTABLEPART
   WHERE DBNAME = 'dbname'
    AND TSNAME = 'psname';
```

```
SELECT DBNAME, IXNAME, IPREFIX
   FROM SYSIBM.SYSINDEXES X, SYSIBM.SYSINDEXPART Y
   WHERE X.NAME = Y.IXNAME
    AND X.CREATOR = Y.IXCREATOR
    AND X.DBNAME = 'dbname'
    AND X.INDEXSPACE = 'psname';
```

GUPI

Defining shadow data sets

Consider the following actions when you preallocate the data sets:

- Allocate the shadow data sets according to the rules for user-managed data sets.
- Define the shadow data sets as LINEAR.
- Use SHAREOPTIONS(3,3).
- Define the shadow data sets as EA-enabled if the original table space or index space is EA-enabled.
- Allocate the shadow data sets on the volumes that are defined in the storage group for the original table space or index space.

If you specify a secondary space quantity, DB2 does not use it. Instead, DB2 uses the SECQTY value for the table space or index space.

Recommendation: Use the MODEL option, which causes the new shadow data set to be created like the original data set. This method is shown in the following example:

```
DEFINE CLUSTER +
   (NAME('catname.DSNDBC.dbname.psname.x0001.L001') +
   MODEL('catname.DSNDBC.dbname.psname.y0001.L001')) +
```

```
DATA                                              +
(NAME('catname.DSNDBD.dbname.psname.x0001.L001') +
MODEL('catname.DSNDBD.dbname.psname.y0001.L001') )
```

Creating shadow data sets for indexes

DB2 treats preallocated shadow data sets as DB2-managed data sets.

When you preallocate shadow data sets for indexes, create the data sets as follows:

- Create shadow data sets for the partition of the table space and the corresponding partition in each partitioning index and data-partitioned secondary index.
- Create a shadow data set for logical partitions of nonpartitioned secondary indexes.

Use the same naming scheme for these index data sets as you use for other data sets that are associated with the base index, except use J0001 instead of I0001.

Estimating the size of shadow data sets

If you do not change the value of FREEPAGE or PCTFREE, the amount of space that is required for a shadow data set is approximately comparable to the amount of space that is required for the original data set.

Concurrency and compatibility for REORG INDEX

The REORG INDEX utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual index partitions as distinct target objects. Utilities that operate on different partitions of the same index space are compatible.

Claims

The following table shows which claim classes REORG INDEX drains and any restrictive state the utility sets on the target object. The target is an index or index partition.

Table 72. Claim classes of REORG INDEX operations

Phase	REORG INDEX SHRLEVEL NONE	REORG INDEX SHRLEVEL REFERENCE	REORG INDEX SHRLEVEL CHANGE
UNLOAD	DW/UTRO	DW/UTRO	CR/UTRW
BUILD	DA/UTUT	none	none
Last iteration of LOG	n/a	DA/UTUT[1]	DW/UTRO
SWITCH	n/a	DA/UTUT	DA/UTUT

Table 72. Claim classes of REORG INDEX operations (continued)

Phase	REORG INDEX SHRLEVEL NONE	REORG INDEX SHRLEVEL REFERENCE	REORG INDEX SHRLEVEL CHANGE

Legend:
- CR: Claim the read claim class.
- DA: Drain all claim classes, no concurrent SQL access.
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTRO: Utility restrictive state, read only access allowed.
- UTUT: Utility restrictive state, exclusive control.
- none: Any claim, drain, or restrictive state for this object does not change in this phase.

Note:

1. Applicable if you specified DRAIN ALL.

Compatibility

The following table shows which utilities can run concurrently with REORG INDEX on the same target object. The target object can be an index space or a partition. If compatibility depends on particular options of a utility, that is also shown. REORG INDEX does not set a utility restrictive state if the target object is an index on DSNDB01.SYSUTILX.

Table 73. Compatibility of REORG INDEX with other utilities

Action	REORG INDEX SHRLEVEL NONE, REFERENCE, or CHANGE
CHECK DATA	No
CHECK INDEX	No
CHECK LOB	Yes
COPY INDEXSPACE	No
COPY TABLESPACE	Yes
DIAGNOSE	Yes
LOAD	No
MERGECOPY	Yes
MODIFY	Yes
QUIESCE	No
REBUILD INDEX	No
RECOVER INDEX	No
RECOVER INDEXSPACE	No
RECOVER TABLESPACE (with no options)	Yes
RECOVER TABLESPACE ERROR RANGE	Yes
RECOVER TABLESPACE TOCOPY or TORBA	No
REORG INDEX SHRLEVEL NONE, REFERENCE, or CHANGE	No
REORG TABLESPACE SHRLEVEL NONE UNLOAD CONTINUE or PAUSE, REORG SHRLEVEL REFERENCE, or REORG SHRLEVEL CHANGE	No

Table 73. Compatibility of REORG INDEX with other utilities (continued)

Action	REORG INDEX SHRLEVEL NONE, REFERENCE, or CHANGE
REORG TABLESPACE SHRLEVEL NONE UNLOAD ONLY or EXTERNAL with cluster index	No
REORG TABLESPACE SHRLEVEL NONE UNLOAD ONLY or EXTERNAL without cluster index	Yes
REPAIR LOCATE INDEX PAGE REPLACE	No
REPAIR LOCATE KEY	No
REPAIR LOCATE RID DELETE	No
REPAIR LOCATE RID DUMP, VERIFY, or REPLACE	Yes
REPAIR LOCATE TABLESPACE PAGE REPLACE	Yes
REPORT	Yes
RUNSTATS INDEX	No
RUNSTATS TABLESPACE	Yes
STOSPACE	Yes
UNLOAD	Yes

To run on SYSIBM.DSNLUX01 or SYSIBM.DSNLUX02, REORG INDEX must be the only utility in the job step and the only utility that is running in the DB2 subsystem.

Determining which indexes require reorganization

Reorganizing indexes might improve performance. To determine which indexes to reorganize to potentially gain such a performance improvement, you can analyze certain data in the DB2 catalog. You can then reorganize these indexes by using the REORG INDEX utility.

Procedure

To determine which indexes require reorganization:

1. Issue the following SQL statement to identify user-created indexes and DB2 catalog indexes to consider reorganizing with the REORG INDEX utility:

   PSPI

   ```
   EXEC SQL
   SELECT IXNAME, IXCREATOR
   FROM SYSIBM.SYSINDEXPART
   WHERE LEAFDIST > 200
   ENDEXEC
   ```

   PSPI

   Using a LEAFDIST value of more than 200 as an indicator of a disorganized index is merely a rough guideline for general cases. This guidance is not absolute. In some cases, 200 is an acceptable value for LEAFDIST. For example, with FREEPAGE 0 and index page splitting, the LEAFDIST value can climb sharply. In this case, a LEAFDIST value that exceeds 200 can be acceptable.

2. Issue the following SQL statement to determine the average distance (multiplied by 100) between successive leaf pages during sequential access of the index. PSPI

```
EXEC SQL
SELECT LEAFDIST
FROM SYSIBM.SYSINDEXPART
WHERE IXCREATOR = 'index_creator_name'
AND IXNAME = 'index_name'
ENDEXEC
```

PSPI

An increase in the LEAFDIST value over time probably indicates that the index needs to be reorganized. The optimal value of the LEAFDIST catalog column is zero. However, immediately after you run the REORG and RUNSTATS utilities, LEAFDIST might be greater than zero as a result of empty pages for FREEPAGE and non-leaf pages.

Using the LEAFDISTLIMIT and REPORTONLY options to determine when reorganization is needed

You can determine when to run REORG for indexes by using the LEAFDISTLIMIT and REPORTONLY options.

About this task

Procedure

To determine when reorganization is needed:

1. Run the REORG INDEX utility and specify the LEAFDISTLIMIT option and the REPORTONLY option. REORG produces a report with one of the following return codes; but a REORG is not performed.
   - **1** No limit met; no REORG performed or recommended.
   - **2** REORG performed or recommended.
2. Optional: Alternatively, information from the SYSINDEXPART catalog table can tell you which indexes qualify for reorganization.

Related tasks:

Maintaining data organization (DB2 Performance)

Determining when to reorganize indexes (DB2 Performance)

Related reference:

SYSIBM.SYSINDEXPART table (DB2 SQL)

Access with REORG INDEX SHRLEVEL

You can specify the level of access that you have to your data by using the SHRLEVEL option.

For reorganizing an index or a partition of an index, the SHRLEVEL option lets you choose the level of access that you have to your data during reorganization:

- REORG with SHRLEVEL NONE, the default, reloads the reorganized data into the original area that is being reorganized. Applications have read-only access during unloading and no access during reloading. SHRLEVEL NONE is the only access level that resets REORG-pending status.

- REORG with SHRLEVEL REFERENCE reloads the reorganized data into a new (shadow) copy of the area that is being reorganized. Near the end of reorganization, DB2 switches applications' future access from the original to the shadow copy. For SHRLEVEL REFERENCE, applications have read-only access during unloading and reloading, and a brief period of no access during switching.
- REORG with SHRLEVEL CHANGE reloads the reorganized data into a shadow copy of the area that is being reorganized. Applications can read from and write to the original area, and DB2 records the writing in the log. DB2 then reads the log and applies it to the shadow copy to bring the shadow copy up to date. This step executes iteratively, with each iteration processing a sequence of log records. Near the end of reorganization, DB2 switches applications' future access from the original to the shadow copy. Applications have read-write access during unloading and reloading, a brief period of read-only access during the last iteration of log processing, and a brief period of no access during switching.

Log processing with SHRLEVEL CHANGE

When you specify SHRLEVEL CHANGE, DB2 processes the log to update the shadow copy. This step executes iteratively. The first iteration processes the log records that accumulated during the previous iteration. The iterations continue until one of these conditions is met:

- DB2 estimates that the time to perform the log processing in the next iteration will be less than or equal to the time that is specified by MAXRO. If this condition is met, the next iteration is the last.
- DB2 estimates that the switch phase will not start by the deadline specified by DEADLINE. If this condition is met, DB2 terminates reorganization.
- The number of log records that the next iteration will process is not sufficiently lower than the number of log records that were processed in the previous iteration. If this condition is met but the first two conditions are not, DB2 sends message DSNU377I to the console. DB2 continues log processing for the length of time that is specified by DELAY and then performs the action specified by LONGLOG.

Operator actions

LONGLOG specifies the action that DB2 is to perform if log processing is not occurring quickly enough. If the operator does not respond to the console message DSNU377I, the LONGLOG option automatically goes into effect. You can take one of the following actions:

- Execute the START DATABASE(db) SPACENAM(ts)... ACCESS(RO) command and the QUIESCE utility to drain the write claim class. DB2 performs the last iteration, if MAXRO is not DEFER. After the QUIESCE, you should also execute the **ALTER UTILITY** command, even if you do not change any REORG parameters.
- Execute the START DATABASE(db) SPACENAM(ts)... ACCESS(RO) command and the QUIESCE utility to drain the write claim class. Then, after reorganization has made some progress, execute the START DATABASE(db) SPACENAM(ts)... ACCESS(RW) command. This action increases the likelihood that log processing can improve. After the QUIESCE, you should also execute the **ALTER UTILITY** command, even if you do not change any REORG parameters.

- Execute the **ALTER UTILITY** command to change the value of MAXRO. Changing it to a huge positive value, such as 9999999, causes the next iteration to be the last iteration.
- Execute the **ALTER UTILITY** command to change the value of LONGLOG.
- Execute the **TERM UTILITY** command to terminate reorganization.
- Adjust the amount of buffer space that is allocated to reorganization and to applications. This adjustment can increase the likelihood that log processing improve after adjusting the space, you should also execute the **ALTER UTILITY** command, even if you do not change any REORG parameters.
- Adjust the scheduling priorities of reorganization and applications. This adjustment can increase the likelihood that log processing improve. After adjusting the priorities, you should also execute the **ALTER UTILITY** command, even if you do not change any REORG parameters.

DB2 does not take the action specified in the LONGLOG phrase if any one of these events occurs before the delay expires:

- An **ALTER UTILITY** command is issued.
- A **TERM UTILITY** command is issued.
- DB2 estimates that the time to perform the next iteration is likely to be less than or equal to the time specified on the MAXRO keyword.
- REORG terminates for any reason (including the deadline).

When REORG INDEX is used with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, pending definition changes are materialized for pending alterations on the index. Pending changes are not materialized for pending alterations on the table space. If pending alterations are involved only on the index, advisory-REORG pending status (AREOR) is reset from the index. If REORG INDEX with SHRLEVEL REFERENCE or SHRLEVEL CHANGE is run at the partition level, pending definition changes are not materialized.

REORG INDEX with SHRLEVEL NONE proceeds without materializing pending definition changes if there were any on the index being reorganized.

Index statistics are collected and updated in the DB2 catalog when pending definition changes are materialized during REORG INDEX with SHRLEVEL REFERENCE or SHRLEVEL CHANGE.

Creating a FlashCopy image copy with REORG INDEX

As part of REORG INDEX processing, you can use FlashCopy technology to quickly take image copies of the target objects.

About this task

Restriction: You cannot create FlashCopy image copies of indexes that are defined with the COPY NO attribute.

Procedure

To create a FlashCopy image copy with REORG INDEX:

Specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT) in the REORG INDEX utility control statement. Alternatively, you can set the FLASHCOPY_REORG_INDEX subsystem parameter to YES, which specifies that

REORG INDEX is to use FLASHCOPY(YES) by default. The value that you specify for the FLASHCOPY option in the REORG INDEX statement always overrides the value for the FLASHCOPY_REORG_INDEX subsystem parameter.
Optionally, you can also specify FCCOPYDDN in the REORG INDEX statement. Use this option to specify a template for the FlashCopy image copy. If you do not specify the FCCOPYDDN option in the REORG INDEX statement, the utility uses the value from the FCCOPYDDN subsystem parameter.

Restriction: The data sets that you specify for the FlashCopy image copy must be on FlashCopy Version 2 disk volumes.
When you specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT), REORG INDEX uses FlashCopy technology to create a consistent copy of the target objects. The FlashCopy image copy fails if the FlashCopy Version 2 disk volumes are not available or if any of the other FlashCopy operational restrictions exist. For a list of those operational restrictions, see "FlashCopy image copies" on page 163.

Related concepts:

"FlashCopy image copies" on page 163

Related reference:

DEFAULT TEMPLATE field (FCCOPYDDN subsystem parameter) (DB2 Installation and Migration)

REORG INDEX field (FLASHCOPY_REORG_INDEX subsystem parameter) (DB2 Installation and Migration)

Temporarily interrupting REORG

You can temporarily pause REORG.

If you specify UNLOAD PAUSE, REORG pauses after unloading the index space into the work data set. The job completes with return code 4. You can restart REORG by using the phase restart or current restart. The REORG statement must not be altered.

The SYSIBM.SYSUTIL record for the REORG INDEX utility remains in "stopped" status until REORG is restarted or terminated.

While REORG is interrupted by PAUSE, you can re-define the table space attributes for user defined table spaces. PAUSE is not required for STOGROUP-defined table spaces. Attribute changes are done automatically by a REORG following an ALTER INDEX.

Improving performance with REORG INDEX

You can improve the performance of the REORG INDEX utility by taking certain actions.

About this task

Recommendation: Run online REORG during light periods of activity on the table space or index.

Procedure

To improve REORG performance:

- Run REORG concurrently on separate partitions of a partitioned index space. The processor time for running REORG INDEX on partitions of a partitioned index is approximately the same as the time for running a single REORG index job. The elapsed time is a fraction of the time for running a single REORG job on the entire index.
- Schedule REORG with SHRLEVEL CHANGE when the rate of writing is low and transactions are short. Avoid scheduling REORG with SHRLEVEL CHANGE when low-tolerance applications are executing.
- Run REORG with DRAIN_WAIT.

  The DRAIN_WAIT option provides improved control over the time online REORG waits for drains. Also, because the DRAIN_WAIT is the aggregate time that online REORG is to wait to perform a drain on a table space and associated indexes, the length of drains is more predictable than it is when each partition and index has its own individual waiting-time limit.

  By specifying a short delay time (less than the system timeout value, IRLMRWT), you can reduce the impact on applications by reducing timeouts. You can use the RETRY option to provide opportunities for the online REORG INDEX utility to complete successfully. If you do not want to use RETRY processing, you can still use DRAIN_WAIT to set a specific and more consistent limit on the length of drains.

  RETRY allows an online REORG that is unable to drain the objects it requires to try again after a set period (RETRY_DELAY). If the drain fails in the SWITCH phase, the objects remain in their original state (read-only mode for SHRLEVEL REFERENCE or read-write mode for SHRLEVEL CHANGE). Likewise, objects will remain in their original state if the drain fails in the LOG phase.

  Because application SQL statements can queue behind any unsuccessful drain that the online REORG has tried, define a reasonable delay before you try again to allow this work to complete; the default is 5 minutes.

  When the default DRAIN WRITERS is used with SHRLEVEL CHANGE and RETRY, multiple read-only log iterations can occur. Because online REORG can have to do more work when RETRY is specified, multiple or extended periods of restricted access might occur. Applications that run with REORG must perform frequent commits. During the interval between retries, the utility is still active; consequently, other utility activity against the table space and indexes is restricted.

Termination of REORG INDEX

You can terminate the REORG INDEX utility.

If you terminate REORG with the **TERM UTILITY** command during the UNLOAD phase, objects have not yet been changed, and you can rerun the job.

If you terminate REORG with the **TERM UTILITY** command during the build phase, the behavior depends on the SHRLEVEL option:

- For SHRLEVEL NONE, the index is left in RECOVER-pending status. After you recover the index, rerun the REORG job.
- For SHRLEVEL REFERENCE or CHANGE, the index keys are reloaded into a shadow index, so the original index has not been affected by REORG. You can rerun the job.

If you terminate REORG with the **TERM UTILITY** command during the log phase, the index keys are reloaded into a shadow index, so the original index has not been affected by REORG. You can rerun the job.

If you terminate REORG with the **TERM UTILITY** command during the switch phase, all data sets that were renamed to their shadow counterparts are renamed back, so the objects are left in their original state. You can rerun the job. If a problem occurs in renaming to the original data sets, the objects are left in RECOVER-pending status. You must recover the index.

The REORG-pending status is not reset until the UTILTERM execution phase. If the REORG INDEX utility abnormally terminates or is terminated, the objects are left in RECOVER-pending status.

The following table lists any restrictive states that are set based on the phase in which REORG INDEX terminated.

Table 74. Restrictive states set based on the phase in which REORG INDEX terminated

Phase	Effect on restrictive status
UNLOAD	No effect.
BUILD	Sets REBUILD-pending (RBDP) status at the beginning of the build phase, and resets RBDP at the end of the phase. SHRLEVEL NONE places an index that was defined with the COPY YES attribute in RECOVER pending (RECP) status.
LOG	No effect.
SWITCH	Under certain conditions, if **TERM UTILITY** is issued, it must complete successfully; otherwise, objects might be placed in RECP status or RBDP status. For SHRLEVEL REFERENCE or CHANGE, sets the RECP status if the index was defined with the COPY YES attribute at the beginning of the switch phase, and resets RECP at the end of the phase. If the index was defined with COPY NO, this phase sets the index in RBDP status at the beginning of the phase, and resets RBDP at the end of the phase.

Related reference:

Appendix C, “Advisory or restrictive states,” on page 1103

Restart of REORG INDEX

You can restart a REORG INDEX utility job.

If you restart REORG in the outlined phase, it re-executes from the beginning of the phase. DB2 always uses RESTART(PHASE) by default unless you restart the job in the UNLOAD phase. In this case, DB2 uses RESTART(CURRENT) by default.

If REORG abnormally terminates or a system failure occurs while it is in the UTILTERM phase, you must restart the job with RESTART(PHASE).

The following table provides information about restarting REORG INDEX. For each phase of REORG and for each type of REORG INDEX (with SHRLEVEL NONE, with SHRLEVEL REFERENCE, and with SHRLEVEL CHANGE), the table indicates the types of restart that are allowed (CURRENT and PHASE). None indicates that no restart is allowed. The "Data sets required" column lists the data sets that must exist to perform the specified type of restart in the specified phase.

Table 75. REORG INDEX utility restart information

Phase	Type of restart allowed for SHRLEVEL NONE	Type of restart allowed for SHRLEVEL REFERENCE	Type of restart allowed for SHRLEVEL CHANGE	Data sets required	Notes
UNLOAD	CURRENT, PHASE	CURRENT, PHASE	None	SYSUT1	
BUILD	CURRENT, PHASE	CURRENT, PHASE	None	SYSUT1	1
LOG	Phase does not occur	Phase does not occur	None	None	
SWITCH	Phase does not occur	CURRENT, PHASE	CURRENT, PHASE	originals and shadows	1

Note:

1. You can restart the utility with either RESTART or RESTART(PHASE). However, because this phase does not take checkpoints, RESTART always re-executes from the beginning of the phase.

If you restart a REORG STATISTICS job that was stopped in the BUILD phase by using RESTART CURRENT, inline statistics collection does not occur. To update catalog statistics, run the RUNSTATS utility after the restarted job completes. Restarting a REORG STATISTICS job with RESTART(PHASE) is conditional after executing UNLOAD PAUSE. To determine if catalog table statistics are to be updated when you restart a REORG STATISTICS job, see the following table. This table lists whether or not statistics are updated based on the execution phase and whether the job is restarted with RESTART(CURRENT) or RESTART(PHASE).

Table 76. Whether statistics are updated when REORG INDEX STATISTICS jobs are restarted in certain phases

Phase	RESTART CURRENT	RESTART PHASE
UTILINIT	No	Yes
UNLOAD	No	Yes
BUILD	No	Yes

Related tasks:

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Review of REORG INDEX output

The output from REORG INDEX consists of a reorganized index or index partition.

The following table summarizes the results of REORG INDEX based upon what you specified.

Table 77. Summary of the results of REORG INDEX

Specification	Results
REORG INDEX	Entire index (all partitions of a partitioned index)
REORG INDEX PART *n*	Part *n* of partitioned index

When reorganizing an index, REORG leaves free pages and free space on each page in accordance with the current values of the FREEPAGE and PCTFREE parameters. (You can set those values by using the CREATE INDEX or ALTER INDEX statement.) REORG leaves one free page after reaching the FREEPAGE limit for each table in the index space.

Catalog updates: REORG INDEX updates SYSINDEXPART OLDEST_VERSION and SYSINDEXES OLDEST_VERSION (if applicable).

Effect of REORG INDEX on index version numbers

DB2 stores the range of used index version numbers in the OLDEST_VERSION and CURRENT_VERSION columns of the SYSIBM.SYSINDEXES and SYSIBM.SYSINDEXPART catalog tables.

The OLDEST_VERSION column contains the oldest used version number, and the CURRENT_VERSION column contains the current version number.

When you run REORG INDEX, the utility updates this range of used version numbers for indexes that are defined with the COPY NO attribute. REORG INDEX sets the OLDEST_VERSION column to the current version number, which indicates that only one version is active; DB2 can then reuse all of the other version numbers.

Recycling of version numbers is required when all of the version numbers are being used. All version numbers are being used when one of the following situations is true:

- The value in the CURRENT_VERSION column is one less than the value in the OLDEST_VERSION column.
- The value in the CURRENT_VERSION column is 15 and the value in the OLDEST_VERSION column is 0 or 1.

You can also run LOAD REPLACE, REBUILD INDEX, or REORG TABLESPACE to recycle version numbers for indexes that are defined with the COPY NO attribute. To recycle version numbers for indexes that are defined with the COPY YES attribute or for table spaces, run MODIFY RECOVERY.

Related concepts:

Table space versions (DB2 Administration Guide)

Sample REORG INDEX control statements

Use the sample control statements as models for developing your own REORG INDEX control statements.

Example 1: Reorganizing an index

The following control statement specifies that the REORG INDEX utility is to reorganize index XMSGTXT1. The UNLOAD PAUSE option indicates that after the data has been unloaded, the utility is to stop. Processing can be restarted in the RELOAD phase. This option is useful if you want to redefine data sets during reorganization.

```
REORG INDEX DSN8B10.XMSGTXT1
 UNLOAD PAUSE
```

Example 2: Collecting inline statistics while reorganizing an index.

The following control statement specifies that REORG INDEX is to collect statistics for index XEMPL1 while reorganizing that index. The SHRLEVEL REFERENCE option indicates that during this processing, only read access is allowed on the areas that are being reorganized.

```
REORG INDEX DSN8B10.XEMPL1
   SHRLEVEL REFERENCE STATISTICS
```

Example 3: Updating access path statistics in the catalog and catalog history tables while reorganizing an index

The following control statement specifies that while reorganizing index IU0E0801, REORG INDEX is to collect statistics and update access path statistics in the catalog and catalog history tables. The utility is also to send any output, including space and access path statistics, to SYSPRINT.

```
REORG INDEX IUOE0801
        STATISTICS
        REPORT YES
        UPDATE ACCESSPATH
        HISTORY ACCESSPATH
```

Example 4: Reorganizing a list of indexes

In the following control statement, the OPTIONS utility control statement specifies that the subsequent TEMPLATE and LISTDEF utility control statements are to run in PREVIEW mode. If the syntax of these statements is correct, DB2 expands the REORG_INDX list and the data set names in the SREC, SUT1, and SOUT templates and prints these results to the SYSPRINT data set. The second OPTIONS control statement turns off the PREVIEW mode, and the subsequent REORG INDEX job runs normally.

The REORG INDEX statement specifies that the utility is to reorganize the indexes that are included in the REORG_INDX list. The SHRLEVEL CHANGE option indicates that during this processing, read and write access is allowed on the areas that are being reorganized, with the exception of a 100-second period during the last iteration of log processing. During this time, which is specified by the MAXRO option, applications have read-only access. The WORKDDN option indicates that REORG INDEX is to use the data set that is defined by the SUT1 template. If the SWITCH phase does not begin by the deadline that is specified on the DEADLINE option, processing terminates.

```
//STEP2    EXEC DSNUPROC,UID='HUHRU257.REORGI',TIME=1440,
//         UTPROC='',
//         SYSTEM='SSTR',DB2LEV=DB2A
//SYSIN    DD *
   OPTIONS PREVIEW
   TEMPLATE SREC
            UNIT(SYSDA) DISP(NEW,CATLG,CATLG)
            DSN(HUHRU257.REORG.&ST..SREC)
   TEMPLATE SUT1
            UNIT(SYSDA) DISP(NEW,DELETE,CATLG)
            DSN(HUHRU257.REORG.&ST..SUT1)
   TEMPLATE SOUT
            UNIT(SYSDA) DISP(NEW,DELETE,CATLG)
            DSN(HUHRU257.REORG.&ST..SOUT)
   LISTDEF REORG_INDX INCLUDE INDEX ADMF001.IPHR5701
                      INCLUDE INDEX ADMF001.IXHR570*
   OPTIONS OFF
    REORG INDEX LIST REORG_INDX
      PREFORMAT
      SHRLEVEL CHANGE
      DEADLINE 2010-2-4-23.10.12
      MAXRO 100
        WORKDDN (SUT1)
/*
```

Figure 64. Example statements for job that reorganizes a list of indexes

Example 5: Creating a FlashCopy image copy with REORG INDEX

The following REORG INDEX control statement reorganizes the index spaces associated with table space DSN8S81E and creates a FlashCopy image copy of the index.

```
//SYSADMA JOB (ACCOUNT),'NAME',NOTIFY=&SYSUID
//*
//UTIL EXEC DSNUPROC,SYSTEM=VA1A,UID='TEMP',UTPROC=''
//DSNUPROC.SYSREC DD DSN=SYSOPS.DSNAME,
// DISP=(NEW,DELETE),
// SPACE=(CYL,(20,20),RLSE),
// UNIT=SYSDA,VOL=SER=SCR03
//DSNUPROC.SYSUT1 DD DSN=SYSOPS.SYSUT1,
// DISP=(NEW,DELETE,DELETE),
// SPACE=(CYL,(9,90),RLSE),
// UNIT=SYSDA,VOL=SER=SCR03
//DSNUPROC.SYSIN DD *
LISTDEF COPY_LIST INCLUDE INDEXSPACES TABLESPACE DSN8D81A.DSN8S81E PARTLEVEL ALL
TEMPLATE SCOPY UNIT(SYSDA) DISP(NEW,CATLG,DELETE)
DSN(DSNT1.&DB..&TS..CPY1.D&TIME.)
TEMPLATE FCOPY UNIT(SYSDA) DISP(NEW,CATLG,DELETE)
DSN(DSNFC.&DB..&TS..P&PA..D&TIME.)
REORG INDEX LIST COPY_LIST SHRLEVEL REFERENCE FLASHCOPY YES
FCCOPYDDN(FCOPY) COPYDDN(SCOPY)
```

Example 6: Reorganizing clone indexes

The following control statement specifies that REORG INDEX is to reorganize only the specified index spaces that contain indexes on clone tables. The SHRLEVEL CHANGE option indicates that during this processing, applications can read and write to the area.

```
REORG INDEX ADMF001.IPJM0901 SHRLEVEL CHANGE CLONE
```

Chapter 29. REORG TABLESPACE

The REORG TABLESPACE online utility reorganizes a table space to improve access performance and to reclaim fragmented space. In addition, the utility can reorganize a single partition or range of partitions of a partitioned table space.

You can specify the degree of access to your data during reorganization. If you specify REORG TABLESPACE UNLOAD EXTERNAL, the data is unloaded in a format that is acceptable to the LOAD utility of any DB2 subsystem. You can also delete rows during the REORG job by specifying the DISCARD option.

To avoid the cost of running the RUNSTATS utility afterward, you can also specify the STATISTICS option to collect inline statistics when you run the REORG TABLESPACE utility.

You can determine when to run REORG for non-LOB table spaces by using the OFFPOSLIMIT or INDREFLIMIT catalog query options. If you specify the REPORTONLY option, REORG produces a report that indicates whether a REORG is recommended without actually performing the REORG. These options are not applicable and are disregarded if the target object is a directory table space.

Run the REORG TABLESPACE utility on a LOB table space to help increase the effectiveness of prefetch. For a LOB table space, REORG TABLESPACE performs these actions:

- Removes embedded free space
- Attempts to make LOB pages contiguous

If you specify SHRLEVEL REFERENCE, a REORG of a LOB table space makes LOB pages contiguous removes embedded free space, and reclaims physical space.

You can run REORG TABLESPACE SHRLEVEL CHANGE on a LOB table space. REORG TABLESPACE SHRLEVEL CHANGE processes a LOB table space the same as REORG SHRLEVEL REFERENCE except the mapping table is ignored. The restriction for REORG TABLESPACE SHRLEVEL CHANGE on NOT LOGGED table spaces applies to LOB table spaces. REORG TABLESPACE SHRLEVEL CHANGE on a LOB table space uses shadow data sets and includes a LOG phase.

Do not execute REORG on an object if another DB2 holds retained locks on the object or has long-running non-committing applications that use the object. You can use the **DISPLAY GROUP** command to determine whether a member status is failed. You can use the **DISPLAY DATABASE** command with the LOCKS option to determine whether locks are held.

You can execute the REORG TABLESPACE utility on the table spaces in the DB2 catalog database (DSNDB06) and on some table spaces in the directory database (DSNDB01). It cannot be executed on any table space in the DSNDB07 database.

Output

The following table summaries the results of REORG TABLESPACE according to the type of REORG specified.

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Table 78. Summary of REORG TABLESPACE output

Type of REORG specified	Results
REORG TABLESPACE	Reorganizes all data and all indexes.
REORG TABLESPACE PART *n*	Reorganizes data for PART *n* of the table space and PART *n* of all partitioned indexes.
REORG TABLESPACE PART *n:m*	Reorganizes data for PART *n* through PART *m* of the table space and PART *n* through PART *m* of all partitioned indexes.

Note: When SCOPE PENDING is also specified, the REORG TABLESPACE utility reorganizes the specified table space only if it is in REORG-pending or advisory REORG-pending status. For a partitioned table space, REORG TABLESPACE SCOPE PENDING reorganizes only the partitions that are in REORG-pending or advisory REORG-pending status.

If the table space or partition has the COMPRESS YES attribute, the data is compressed when it is reloaded. If you specify the KEEPDICTIONARY option of REORG, the current dictionary is used; otherwise a new dictionary is built. If a table has DATA CAPTURE CHANGES active, any previously existing dictionary is written to the log.

REORG TABLESPACE materializes pending limit key changes if you specify SHRLEVEL REFERENCE or CHANGE.

Authorization required

To execute this utility on a user table space, you must use a privilege set that includes one of the following authorities:

- REORG privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- SYSCTRL authority
- SYSADM authority
- DATAACCESS authority

To execute this utility on a table space in the catalog or directory, you must use a privilege set that includes one of the following authorities:

- REORG privilege for the DSNDB06 (catalog) database
- DBADM or DBCTRL authority for the DSNDB06 (catalog) database
- Installation SYSOPR authority
- SYSCTRL authority
- SYSADM or Installation SYSADM authority
- STATS privilege for the database is required if STATISTICS keyword is specified.

If you specify REORG TABLESPACE SHRLEVEL CHANGE and you create a mapping table, you must use a privilege set that includes DELETE, INSERT, and UPDATE privileges on the mapping table.

When REORG is implicitly creating the mapping objects, you must have the authority to create or drop objects on the target database.

If either the FLASHCOPY YES or FLASHCOPY CONSISTENT option is specified, the user ID that invokes the REORG TABLESPACE utility must have the authority to execute the DFSMSdss COPY command.

To run REORG TABLESPACE STATISTICS REPORT YES, you must use a privilege set that includes the SELECT privilege on the catalog tables and tables for which statistics are to be gathered.

An authority other than installation SYSADM or installation SYSOPR can receive message `DSNT500I resource unavailable`, while trying to reorganize a table space in the catalog or directory. This message can be issued when the DSNDB06.SYSDBAUT or DSNDB06.SYSUSER catalog table space or one of the indexes is unavailable. If this problem occurs, run the REORG TABLESPACE utility again using an authorization ID with the installation SYSADM or installation SYSOPR authority.

If you use RACF access control with multilevel security and REORG TABLESPACE is to process a table space that contains a table that has multilevel security with row-level granularity, you must be identified to RACF and have an accessible valid security label. You must also meet the following authorization requirements: .

- For REORG statements that include the UNLOAD EXTERNAL option, each row is unloaded only if your security label dominates the data security label. If your security label does not dominate the data security label, the row is not unloaded, but DB2 does not issue an error message.
- For REORG statements that include the DISCARD option, qualifying rows are discarded only if one of the following situations are true:
  - Write-down rules are in effect, you have write-down privilege, and your security label dominates the data's security label.
  - Write-down rules are not in effect and your security label dominates the data's security label.
  - Your security label is equivalent to the data security label.

Execution phases of REORG TABLESPACE

The REORG TABLESPACE utility operates in these phases:

UTILINIT
Performs initialization and setup.

UNLOAD
Unloads the table space and sorts data if a clustering index exists and the utility job does not include the SORTDATA NO options. For SORTDATA processing, if you specify NOSYSREC, the utility passes rows in memory to the RELOAD phase; otherwise, it writes them to a sequential data set.

Nonpartitioned indexes are processed in one of two ways:

- If PART SHRLEVEL REFERENCE or PART SHRLEVEL CHANGE is specified, during UNLOAD one or more subtasks unload nonpartitioned indexes and build shadow nonpartitioned indexes.
- If PART SHRLEVEL REFERENCE or CHANGE is specified and SORTNPSI YES or AUTO is specified or subsystem parameter REORG_PART_SORT_NPSI is enabled, during UNLOAD one or more subtasks processes nonpartitioned secondary index keys from parts that are not within the scope of the REORG. These keys are routed to a sort process to be sorted with the keys from parts within the scope of the REORG. The shadow index is built from this sorted set of keys.

RELOAD
Reloads data from the sequential data set into the table space and creates full image copies if you specify COPYDDN, RECOVERYDDN, SHRLEVEL REFERENCE, or SHRLEVEL CHANGE. A subtask sorts the index keys. The utility also updates table and table space statistics.

SORT Sorts index keys. The sorted keys are passed in memory to the BUILD phase.

BUILD
Builds indexes and updates index statistics.

SORTBLD
If parallel index build occurs, all activities that normally occur in both the SORT and BUILD phases occur in the SORTBLD phase instead.

LOG Processes the log iteratively and appends changed pages to the full image copies. This phase occurs only if you specify SHRLEVEL CHANGE or SHRLEVEL REFERENCE PART x.

SWITCH
Switches access to shadow copy of table space or partition. This phase occurs only if you specify SHRLEVEL REFERENCE or CHANGE.

UTILTERM
Performs cleanup.

Execution phases of REORG TABLESPACE on a LOB table space

The REORG TABLESPACE utility operates in these phases when you run it on a LOB table space:

Phase Description

UTILINIT
Performs initialization and setup.

REORGLOB

For SHRLEVEL REFERENCE, the utility unloads LOBs to a shadow data set. RECOVER-pending is not set on the LOB table space. Any error during this phase leaves he original data set intact.

SWITCH
Switches access to shadow copy of table space or partition.

UTILTERM
Performs cleanup.

You cannot restart REORG TABLESPACE on a LOB table space in the REORGLOB phase. Before executing REORG TABLESPACE SHRLEVEL NONE on a LOB table space that is defined with LOG NO, you should take a full image copy to ensure recoverability. For SHRLEVEL REFERENCE, an inline image copy is required to ensure recoverability.

Related tasks:

Maintaining data organization (DB2 Performance)

Collecting statistics by using DB2 utilities (DB2 Performance)

Reducing the cost of collecting statistics (DB2 Performance)

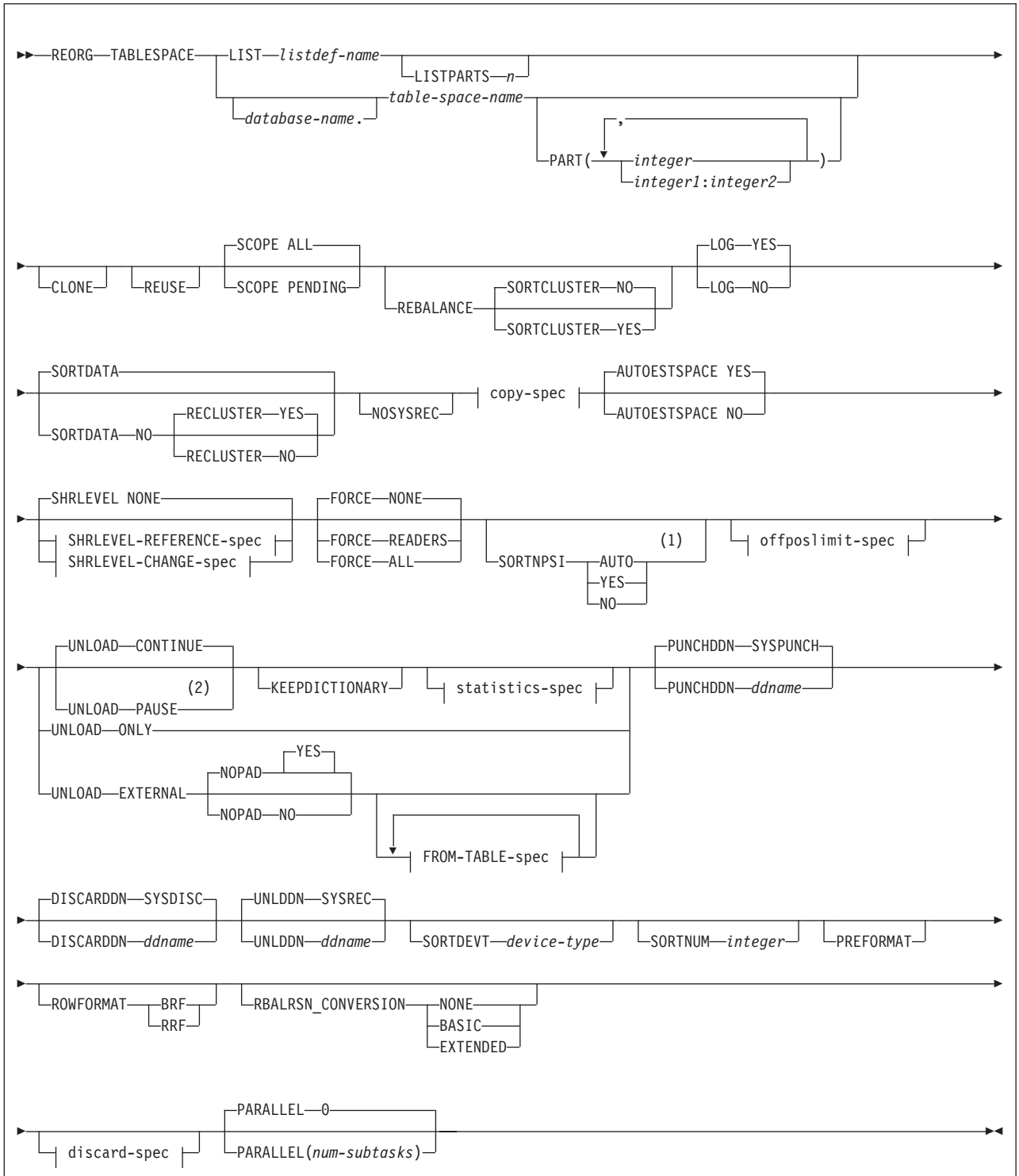
Syntax and options of the REORG TABLESPACE control statement

The REORG TABLESPACE utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Some of these options are not valid for LOB table spaces. For a list of those options, see "Reorganization of a LOB table space" on page 639.

Syntax diagram

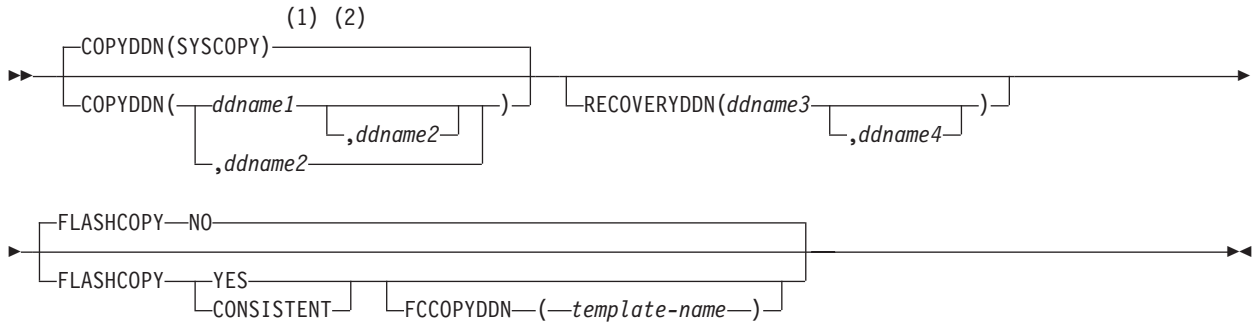


Notes:

1 The default for SORTNPSI is the value of the REORG_PART_SORT_NPSI subsystem parameter.

2 You cannot use UNLOAD PAUSE with the LIST option.

copy-spec:

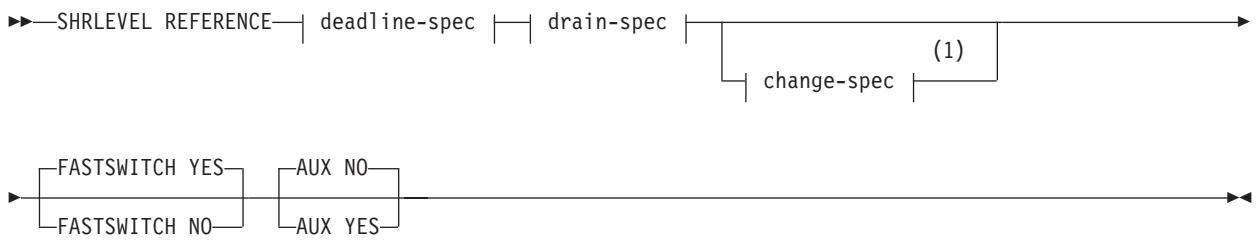


Notes:

1 COPYDDN(SYSCOPY) is not the default if you specify SHRLEVEL NONE, and no partitions are in REORG-pending status.

2 Either COPYDDN or FCCOPYDDN can be specified, or they can both be specified. At least one of these options must be specified for SHRLEVEL NONE when a partition is in REORG-pending status, or for SHRLEVEL CHANGE OR SHRLEVEL REFERENCE. If you specify FCCOPYDDN, but do not specify COPYDDN or a SYSCOPY DD statement or TEMPLATE specification, for SYSCOPY, only a FlashCopy image copy is taken.

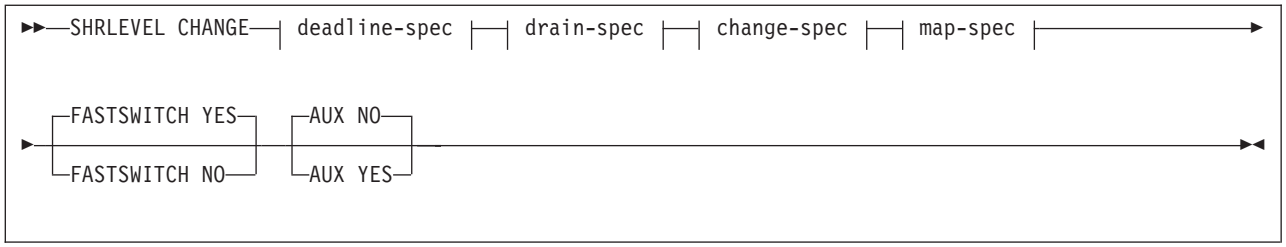
SHRLEVEL-REFERENCE-spec:



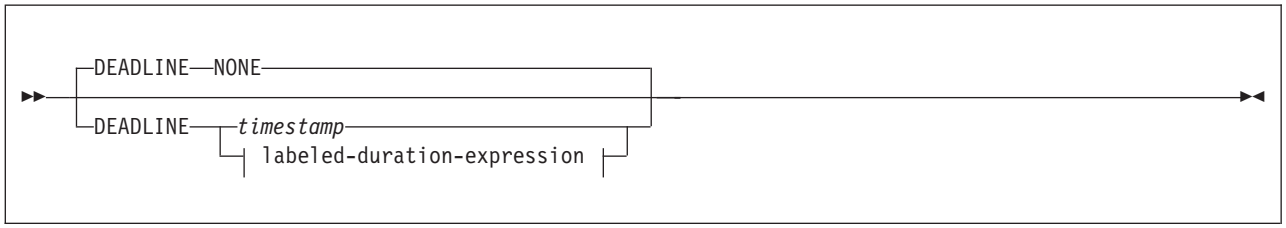
Notes:

1 For SHRLEVEL REFERENCE, the *change-spec* options are ignored. The exception is a partition-level REORG operation on a partitioned table space that has a non-partitioned index. In that case, the *change-spec* options are not ignored.

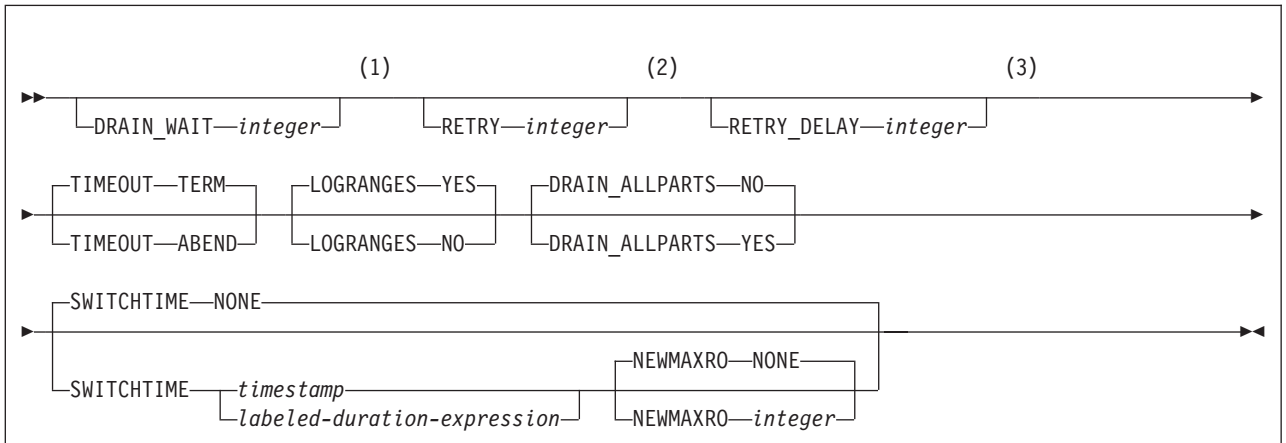
SHRLEVEL-CHANGE-spec:



deadline-spec:



drain-spec:



Notes:

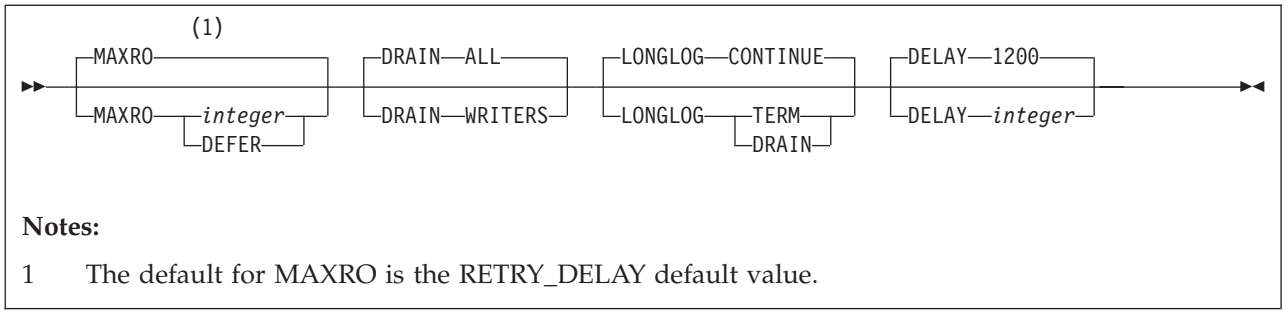
1 The default for DRAIN_WAIT is the value of the IRLMRWT subsystem parameter.

2 The default for RETRY is the value of the UTIMOUT subsystem parameter.

3 The default for RETRY_DELAY is the smaller of the following two values: DRAIN_WAIT value × RETRY value, DRAIN_WAIT value × 10

change-spec:

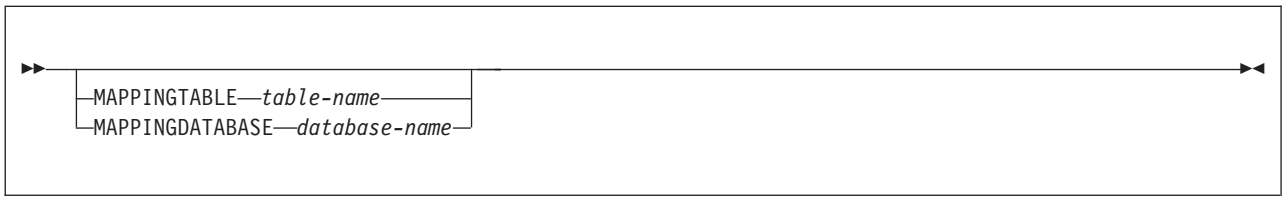
For SHRLEVEL REFERENCE, the *change-spec* options are ignored. The exception is a partition-level REORG operation on a partitioned table space that has a non-partitioned index. In that case, the *change-spec* options are not ignored.



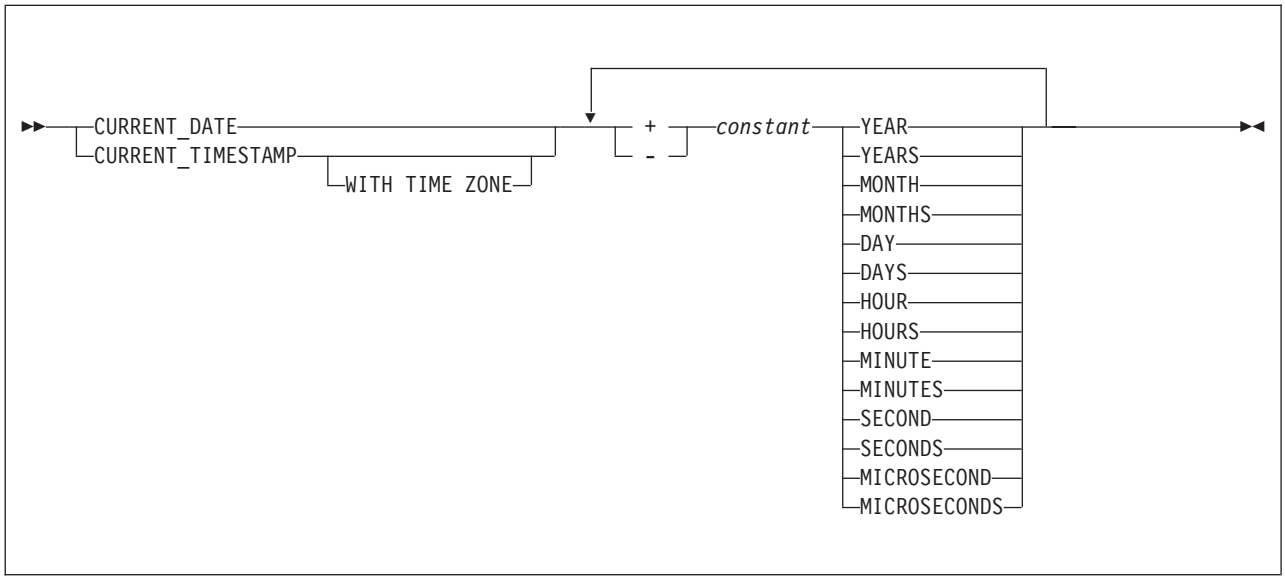
Notes:

1 The default for MAXRO is the RETRY_DELAY default value.

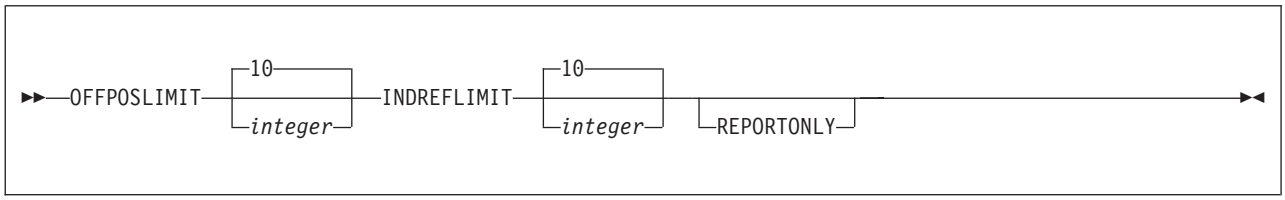
map-spec:



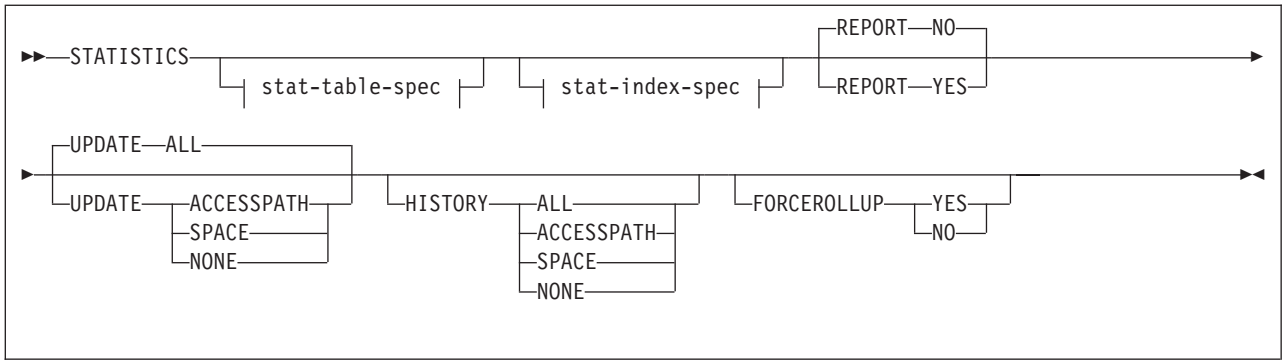
labeled-duration-expression:



offposlimit-spec:



statistics-spec:



stat-table-spec

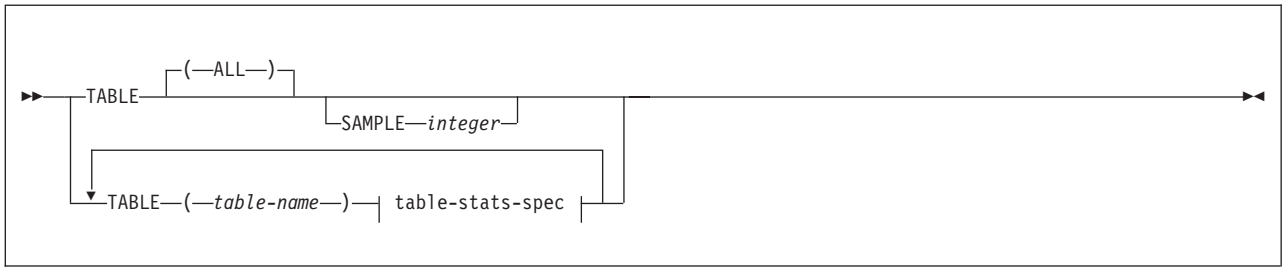
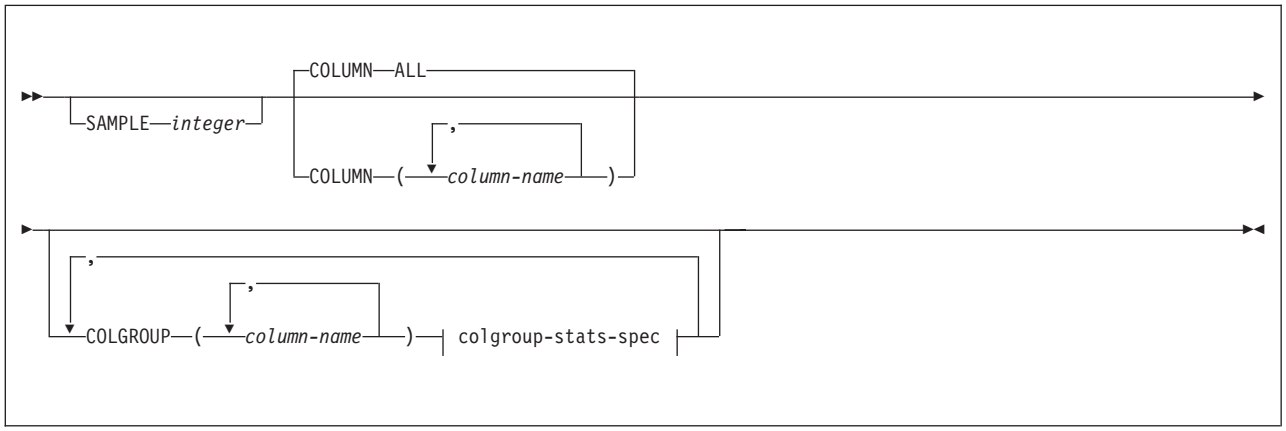
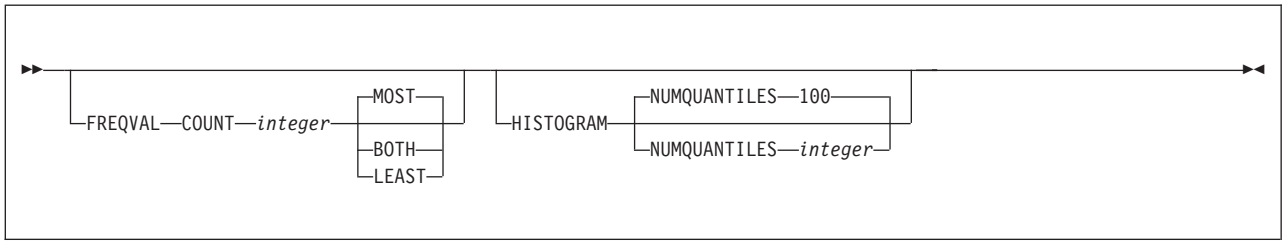


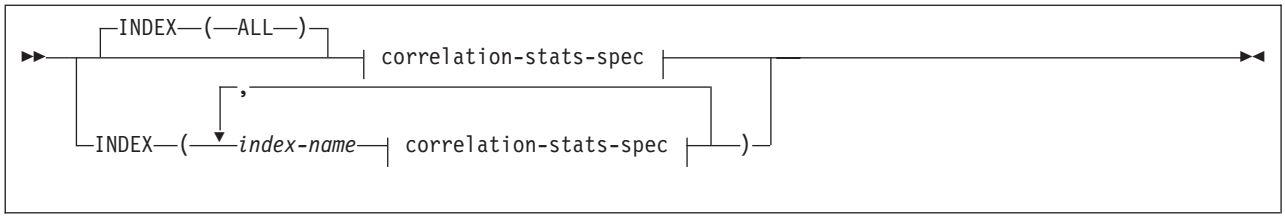
table-stats-spec



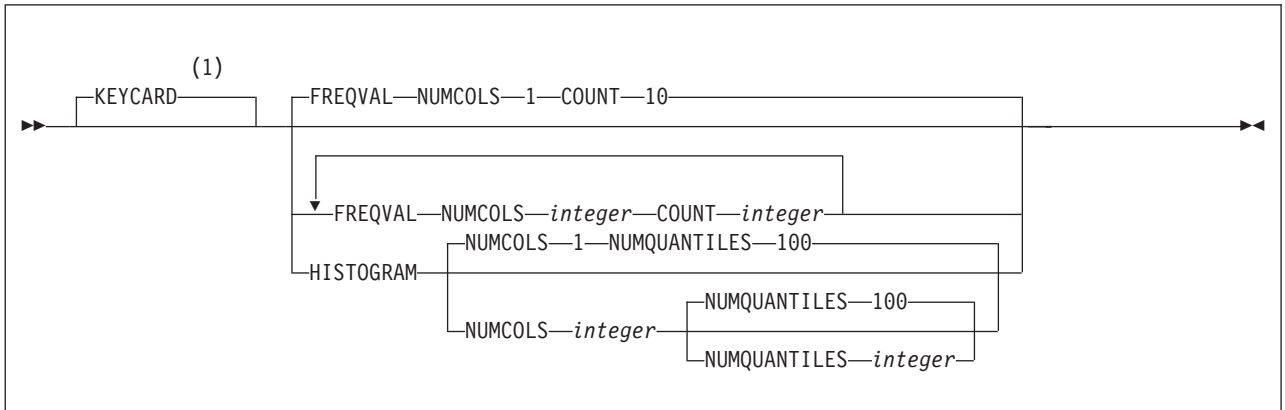
colgroup-stats-spec:



stat-index-spec:



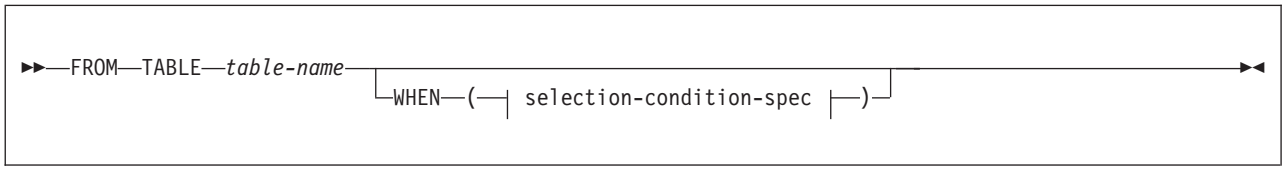
correlation-stats-spec:



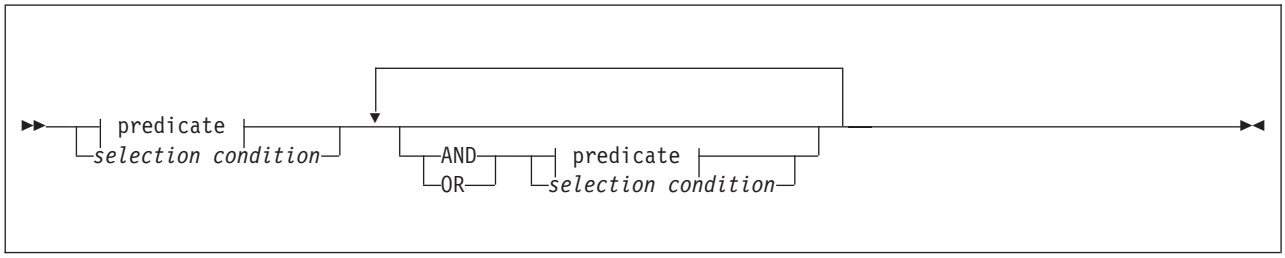
Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the default execution of the inline statistics and cannot be disabled.

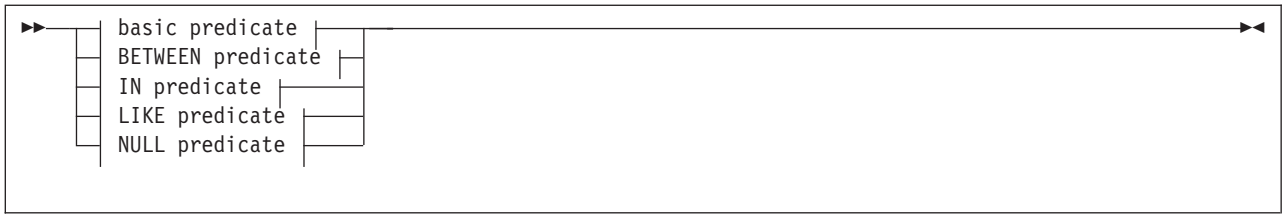
FROM-TABLE-spec:



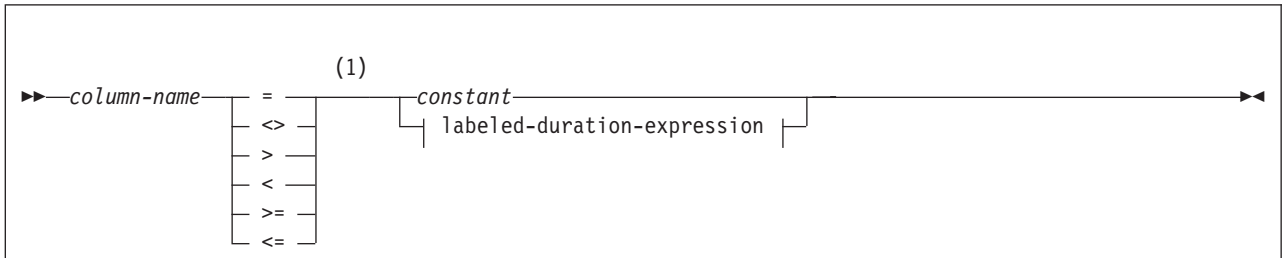
selection-condition-spec:



predicate:



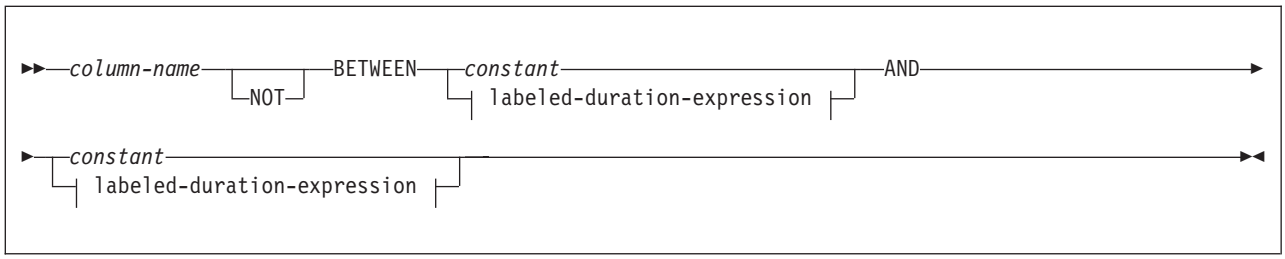
basic predicate:



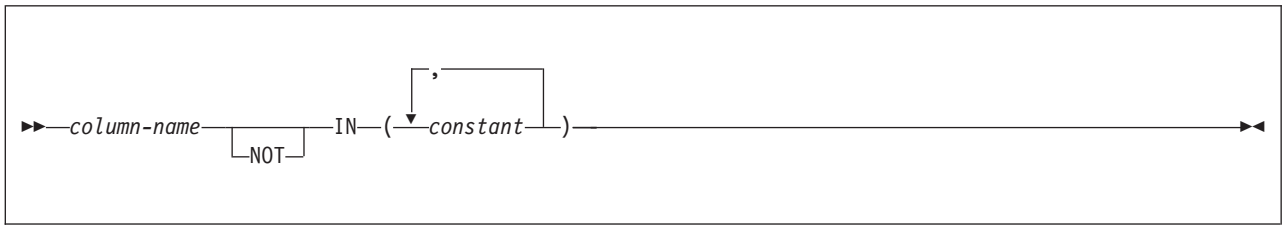
Notes:

1 The following forms of the comparison operators are also supported in basic and quantified predicates: !=, !<, and !>. For details, see comparison operators.

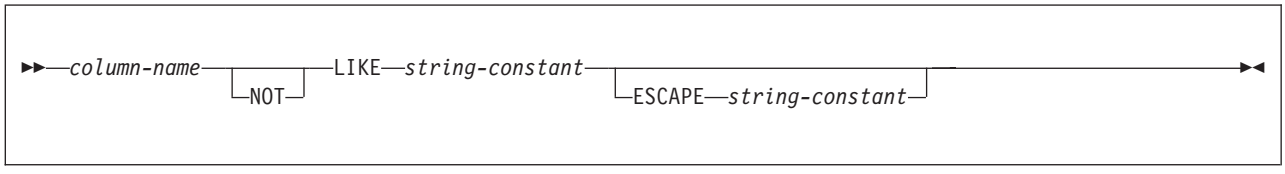
BETWEEN predicate:



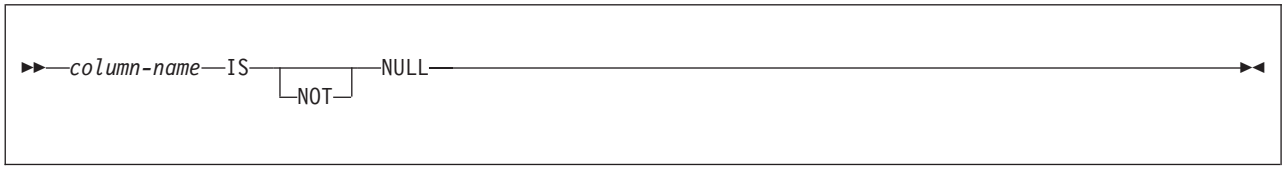
IN predicate:



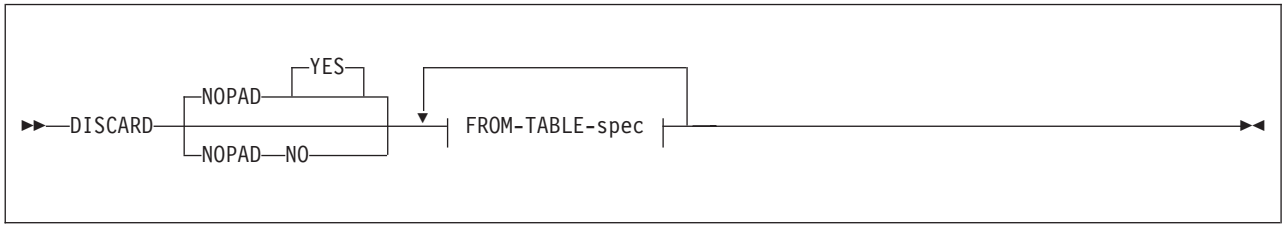
LIKE predicate:



NULL predicate:



discard-spec:



Option descriptions

TABLESPACE *database-name.table-space-name*
Specifies the table space (and, optionally, the database to which it belongs) that is to be reorganized.

If you reorganize a table space, its indexes are also reorganized.

database-name
Is the name of the database to which the table space belongs. The name cannot be DSNDB07.

The default value is **DSNDB04**.

table-space-name
Is the name of the table space that is to be reorganized. The name cannot be SYSUTILX if the specified database name is DSNDB01.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each control statement of REORG TABLESPACE. The list must contain only table spaces.

Do not specify FROM TABLE, STATISTICS TABLE *table-name*, or STATISTICS INDEX *index-name* with REORG TABLESPACE LIST. If you want to collect inline statistics for a list of table spaces, specify STATISTICS TABLE (ALL). If you want to collect inline statistics for a list of indexes, specify STATISTICS INDEX (ALL). Do not specify PART with LIST.

REORG TABLESPACE is invoked once for each item in the list. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

LISTPARTS *n*
Specifies the maximum number of data partitions to be reorganized in a single REORG on a LISTDEF that contains PARTLEVEL list items.

n Specifies an integer that represents the maximum number of data partitions to be reorganized at once. Valid value is greater than 0. If

LISTPARTS is not specified, the default value is the setting of the REORG_LIST_PROCESSING subsystem parameter.

PARALLEL(*num-subtasks***)**

Specifies the maximum number of subtasks that are to be started in parallel to reorganize a table space. If the PARALLEL keyword is omitted, the maximum number of subtasks is limited by either the number of partitions that are being unloaded or the number of indexes that are built.

The value of *num-subtasks* must be an integer between 0 and 32767, inclusive. If the specified value for *num-subtasks* is greater than 32767, the REORG TABLESPACE statement fails. If 0 or no value is specified for *num-subtasks*, the REORG TABLESPACE utility uses the optimal number of parallel subtasks. If the specified value for *num-subtasks* is greater than the calculated optimal number, the REORG TABLESPACE utility limits the number of parallel subtasks to the optimal number with applied constraints.

The specified number of subtasks for PARALLEL always overrides the specification of the PARAMDEG_UTIL subsystem parameter, so PARALLEL can be smaller or larger than the value of PARAMDEG_UTIL.

REORG TABLESPACE uses sophisticated algorithms to allocate subtasks for unloading partitions, reloading partitions, building indexes, applying log changes, and gathering statistics. As a result, the number of subtasks that are started might be less than the number specified on PARALLEL.

CLONE
Indicates that REORG TABLESPACE is to reorganize only clone tables from the specified table spaces. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient. Base tables in the specified table spaces are not reorganized. If you specify CLONE, you cannot specify STATISTICS. Statistics are not collected for clone tables.

REUSE
When used with SHRLEVEL NONE, specifies that REORG is to logically reset and reuse DB2-managed data sets without deleting and redefining them. If you do not specify REUSE and SHRLEVEL NONE, DB2 deletes and redefines DB2-managed data sets to reset them.

If a data set has multiple extents, the extents are not released if you use the REUSE parameter.

REUSE does not apply if you also specify SHRLEVEL REFERENCE or CHANGE.

SCOPE
Indicates the scope of the reorganization of the specified table space or of one or more specified partitions.

ALL
Indicates that you want the specified table space or one or more partitions to be reorganized. The default is ALL.

PENDING
Indicates that you want the specified table space or one or more partitions to be reorganized only if they are in REORG-pending (REORP, AREO*, or AREOR) status.

PART(*integer***)**
PART(*integer1***:***integer2***)**

PART(*integer*,...*integer*,...*integer1*:*integer2*,...*integer1*:*integer2*)**
Identifies the set of partitions that are to be reorganized. The set of partitions must be enclosed in parentheses.

You can reorganize:

- One or more single partitions
- One or more ranges of partitions
- A combination of one or more single partitions and one or more ranges of partitions

The partitions do not need to be consecutive.

integer, *integer1*, and *integer2* are physical partition numbers. Each partition number must be in the range from 1 to the number of partitions that are defined for the table space or partitioning index. The maximum is 4096.

integer
Designates a single partition.

integer1:integer2
Designates a range of existing table space partitions from *integer1* through *integer2*.*integer2* must be greater than *integer1*.

If you omit the PART keyword, the entire table space is reorganized.

If you specify the PART keyword for a LOB table space, DB2 issues an error message, and utility processing terminates with return code 8.

If you specify a partition range and the high or low partitions in the list are in a REORG-pending state, the adjacent partition that is outside the specified range must not be in REORG-pending state; otherwise, the utility terminates with an error.

Restriction: You cannot run concurrent **REORG TABLESPACE SHRLEVEL CHANGE PART** *integer* on the same table space with one or more non-partitioned indexes defined in it. Instead of submitting multiple jobs, you can merge the jobs into one job by specifying all the target partitions in the same REORG job.

REBALANCE
Specifies that REORG TABLESPACE is to set new partition boundaries so that rows are evenly distributed across the reorganized partitions. If the columns that are used in defining the partition boundaries have many duplicate values within the data rows, even balancing is not always possible. Specify REBALANCE for more than one partition; if you specify a single partition for rebalancing, REORG TABLESPACE ignores the specification.

You can specify REBALANCE with SHRLEVEL NONE, SHRLEVEL CHANGE, or SHRLEVEL REFERENCE. You must specify SHRLEVEL REFERENCE or SHRLEVEL CHANGE if the base table space has an associated auxiliary LOB table space. In this case, you must also specify AUX YES, which is the default value if you specify REBALANCE. When REBALANCE is specified with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, pending definition changes for conversion of a partitioned table space to a range-partitioned universal table space are not materialized.

REBALANCE cannot be specified with SCOPE PENDING.

Restrictions: REBALANCE cannot be specified for the following objects:

- Partition-by-growth table spaces

- Base tables with XML columns
- XML table spaces
- An object that is involved in a clone relationship. (Because the base and clone tables share catalog information, REBALANCE can change the partition boundaries of the target table.)
- Table spaces with pending alter limit key changes

When you specify REBALANCE, you must create an inline copy by performing one of the following actions:

- Provide a SYSCOPY DD statement in the JCL.
- Use the TEMPLATE utility to dynamically allocate the SYSCOPY data set.
- Specify a DD name with the COPYDDN option in the REORG control statement and specify either a corresponding DD statement or TEMPLATE statement.

At completion, DB2 invalidates packages and the dynamic cache.

SORTCLUSTER
Determines whether REBALANCE is to attempt to sort the data records into clustering order. This option is ignored if no clustering index exists in the table, or when the limit key columns are identical to or are a superset of the clustering index columns.

NO Specifies that the data records are not to be explicitly sorted into clustering order. This option is the default behavior.

If SORTCLUSTER NO is explicitly specified, REORG-pending advisory (AREO*) status is not set on the affected data partitions upon REORG REBALANCE completion. If SORTCLUSTER NO is not explicitly specified and instead accepted by default, AREO* status can still be set on the affected partitions.

YES
Specifies that the data records are to be explicitly sorted into clustering order as needed.

LOG
Specifies whether records are to be logged during the RELOAD phase of REORG. If the records are not logged, the table space is recoverable only after an image copy is taken. If you specify COPYDDN, FCCOPYDDN, RECOVERYDDN, SHRLEVEL REFERENCE, or SHRLEVEL CHANGE, an image copy is taken during REORG execution.

YES
Specifies that log records are to be taken during the RELOAD phase. This option is not allowed for any table space in DSNDB01 or DSNDB06, or if the SHRLEVEL REFERENCE or CHANGE options are used.

If you specify SHRLEVEL NONE (explicitly or by default), the default value is **YES**.

LOG YES is required for LOB REORG SHRLEVEL NONE. LOG NO is required for LOB REORG SHRLEVEL REFERENCE.

If the table space has the NOT LOGGED attribute, and SHRLEVEL NONE is specified, DB2 does the LOAD with LOG NO.

NO Specifies that records are not to be logged. This option puts the table space in COPY-pending status if REORG is executed at the remote site, and RECOVERYDDN is not specified.

You must specify LOG NO for REORG of a LOB table space if you specify SHRLEVEL REFERENCE.

SORTDATA or SORTDATA NO

SORTDATA specifies that the data is to be unloaded by a table space scan, and sorted in clustering order.

The default value is SORTDATA, unless you specify UNLOAD ONLY or UNLOAD EXTERNAL. If you specify one of these options, the default is SORTDATA NO.

SORTDATA NO specifies that, when possible, the data is to be unloaded in the order of the clustering index. Specify SORTDATA NO if one of the following conditions is true:

- The data is in or near perfect clustering order, and the REORG utility is used to reclaim space from dropped tables.
- The amount of data is very large, and an insufficient amount of disk space is available for sorting.

For a partitioned table space, REORG does not unload the records by way of the clustering index when the clustering index is not partitioning. The data records must be unloaded by partition order first. In addition, when REORG unload or reload partition parallelism is used, or when REORG is run on a partition-by-growth table space, REORG always performs a table space scan to unload the data records, when the clustering index is not used.

Related information:

Clustering indexes (Introduction to DB2 for z/OS)

RECLUSTER

Specifies whether data records are to be reclustered by unloading them by way of the clustering index. For SHRLEVEL CHANGE processing, or when the clustering index has the EXCLUDE NULL KEYS attribute, RECLUSTER NO is always enforced.

YES
Data records are to be reclustered and to be unloaded by the clustering index if one exists. This option is the default behavior.

NO Data records are not to be reclustered and are not unloaded by way of the clustering index.

NOSYSREC

Specifies that REORG TABLESPACE is not to use an unload data set. The utility uses the output of sorting as the input to reload but does not use an unload data set for this process.

Omitting the unload data set can improve performance. However, when you omit the unload data set by specifying NOSYSREC, the following limitations exist for restarting the utility:

- If an error occurs during reloading, you must restart the utility at the beginning of the UNLOAD phase. (If you do not specify NOSYSREC, you can start the utility at the RELOAD phase.)
- If you specify SHRLEVEL NONE and an error occurs during reloading, you must first run the RECOVER utility with the most recent image copy.

If you specify SHRLEVEL NONE with NOSYSREC, create an image copy before you run REORG TABLESPACE.

You cannot specify NOSYSREC with any of the following options:

- SORTDATA NO
- UNLOAD PAUSE
- UNLOAD ONLY

COPYDDN (*ddname1,ddname2***)**
Specifies the DD statements for the primary (*ddname1*) and backup (*ddname2*) copy data sets for the image copy.

ddname1 and *ddname2* are the DD names.

The default value is **SYSCOPY** for the primary copy. A full image copy data set is created when REORG executes. This copy is called an inline copy. The table space does not remain in COPY-pending status regardless of which LOG option you specify.

When an inline copy is performed, DB2 writes a record with ICTYPE='F' in the SYSIBM.SYSCOPY catalog table. The name of the inline copy data set is listed in that record. If an inline copy is performed when REORG is run on a range of partitions, DB2 writes a record with ICTYPE='F' for each partition. The inline copy data set name is the same in all of those records.

If you specify SHRLEVEL NONE (explicitly or by default) for REORG, and COPYDDN is not specified, an image copy is not created at the local site.

COPYDDN(SYSCOPY) is assumed, and a DD statement for SYSCOPY is required if either of the following conditions are true:

- You specify REORG SHRLEVEL REFERENCE or CHANGE, and you do not specify COPYDDN.
- A table space or partition is in REORG-pending (REORP) status.
- You specify REBALANCE.

The COPYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

REORG can take inline copies of XML table spaces.

RECOVERYDDN *(ddname3,ddname4)*
Specifies the DD statements for the primary *(ddname3)* and backup *(ddname4)* copy data sets for the image copy at the recovery site.

ddname3 and *ddname4*are the DD names.

You cannot have duplicate image copy data sets. The same rules apply for RECOVERYDDN as for COPYDDN.

The RECOVERYDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

REORG SHRLEVEL REFERENCE of a LOB table space supports inline copies, but REORG SHRLEVEL NONE does not.

FLASHCOPY
Specifies whether FlashCopy technology is used to create a copy of the object. Valid values are YES, NO, or CONSISTENT. When FlashCopy is used, a separate data set is created for each partition or piece of the object.

The FlashCopy specifications on the utility control statement override any specifications for FlashCopy that are defined by using the DB2 subsystem

parameters. If the FlashCopy subsystem parameters specify the use of FlashCopy as the default behavior of this utility, the FLASHCOPY option can be omitted from the utility control statement.

Important: If the input data set is less than one cylinder, FlashCopy technology might not be used for copying the objects regardless of the FLASHCOPY settings. The copy is performed by IDCAMS if FlashCopy is not used.

NO Specifies that no FlashCopy is made. NO is the default value for FLASHCOPY.

YES
Specifies that FlashCopy technology is used to copy the object.

Specify YES only if the DB2 data sets are on FlashCopy Version 2 disk volumes.

Important: Under the following circumstances, the REORG TABLESPACE utility might not use FlashCopy even though YES is specified:

- FlashCopy Version 2 disk volumes are not available
- The source tracks are already the target of a FlashCopy operation
- The target tracks are the source of a FlashCopy operation
- The maximum number of relationships for the copy is exceeded

If FlashCopy is requested but not used, REORG TABLESPACE completes with return code 8. If no sequential inline copy is requested on the same job, the objects are left in COPY-pending status.

CONSISTENT
Specifies that FlashCopy technology is used to copy the object. Because the copies created by the REORG TABLESPACE utility are already consistent, the utility treats a specification of CONSISTENT the same as a specification of YES.

FCCOPYDN
Specifies the template to be used to create the FlashCopy image copy data set names. If a value is not specified for FCCOPYDN on the REORG TABLESPACE control statement when FlashCopy is used, the value specified on the FCCOPYDN subsystem parameter determines the template to be used.

(*template-name***)**
The data set names for the FlashCopy image copy are allocated according to the template specification. For table space or index space level FlashCopy image copies, because a data set is allocated for each partition or piece, ensure that the data set naming convention in the template specification is unique enough. Use the &DSNUM variable, which resolves to a partition number or piece number at execution time.

AUTOESTSPACE
Specifies that REORG automatically calculates and formats the size of the fixed hash space for hash-organized table spaces. The use of AUTOESTSPACE YES might reduce the number of rows in the overflow area.

YES
Specifies that DB2 uses real-time statistics (RTS) values to adjust the size of the hash space. User-specified HASH SPACE values stored in the SYSIBM.SYSTABLESPACE and SYSIBM.SYSTABLEPART catalog tables are not changed. YES is the default value for AUTOESTSPACE.

NO Specifies that DB2 uses the HASH SPACE value specified for CREATE TABLE or ALTER TABLE. These values are stored in the SYSIBM.SYSTABLESPACE and SYSIBM.SYSTABLEPART catalog tables.

SHRLEVEL

Specifies the method that is to be used for the reorganization. The parameter that follows SHRLEVEL indicates the type of access that is to be allowed during the RELOAD phase of REORG.

NONE

Specifies that reorganization is to operate as follows:

- Unloading from the area that is being reorganized (while applications can read but cannot write to the area)
- Reloading into that area (while applications have no access), and then allowing read/write access again

If you specify NONE (explicitly or by default), you cannot specify the following parameters:

- MAPPINGTABLE
- MAXRO
- LONGLOG
- DELAY
- DEADLINE
- DRAIN_WAIT
- RETRY
- RETRY_DELAY

Restrictions:

- If you specify UNLOAD PAUSE or UNLOAD ONLY, you cannot specify NOSYSREC. SHRLEVEL NONE cannot be specified for tables that are defined with ORGANIZE BY HASH.
- You cannot specify SHRLEVEL NONE in a REORG TABLESPACE control statement that completes the process of recovery to a point in time prior to the materialization of pending definition changes.

When SHRLEVEL NONE is specified, pending definition changes are not materialized and any associated restrictive states are not reset. For example, pending limit key changes are not materialized and the associated advisory REORG-pending status is not reset. (Immediate alter limit key changes can be materialized by REORG SHRLEVEL NONE.)

SHRLEVEL NONE is not supported when REORG is run against a LOB table space.

REFERENCE

Specifies that reorganization is to operate as follows:

- Unloading from the area that is being reorganized (while applications can read but cannot write to the area)
- Reloading into a shadow copy of that area (while applications can read but cannot write to the original copy)
- Switching the future access of an application from the original copy to the shadow copy by exchanging the names of the data sets, and then allowing read/write access again

If you specify SHRLEVEL REFERENCE and FASTSWITCH NO, pending definition changes are not materialized.

If you specify REFERENCE for a LOB table space, you must take an inline copy during the reorganization.

If you specify REFERENCE, you cannot specify the following parameters:

- LOG. Reorganization with REFERENCE always creates an image copy and always refrains from logging records during reloading.
- UNLOAD PAUSE, UNLOAD ONLY, or UNLOAD EXTERNAL. Reorganization with REFERENCE always uses UNLOAD CONTINUE, which is the default value. (You can explicitly specify UNLOAD CONTINUE or none of the UNLOAD options, but you cannot specify UNLOAD PAUSE, UNLOAD ONLY, or UNLOAD EXTERNAL.)
- MAPPINGTABLE.

Specifying REORG TABLESPACE PART SHRLEVEL REFERENCE with the REORG_PART_SORT_NPSI subsystem parameter enabled might require larger sort work data sets because of the increased number of keys sorted for nonpartitioned secondary indexes.

Specifying SHRLEVEL REFERENCE or CHANGE on an entire XML partitioned table space converts the XML table space to extended 10-byte format if one of the following is true:

- The UTILITY OBJECT CONVERSION subsystem parameter is set to EXTENDED or NOBASIC.
- The RBALRSN_CONVERSION EXTENDED keywords are specified.

Restriction: You cannot specify SHRLEVEL REFERENCE when REORG TABLESPACE with PART is run on a NOT LOGGED table space on which nonpartitioned indexes are defined.

CHANGE

Specifies that reorganization is to operate as follows:

- By unloading from the area that is being reorganized (while applications can read and write to the area)
- Reloading into a shadow copy of that area (while applications have read/write access to the original copy of the area)
- Applying the log of the original copy to the shadow copy (while applications can read and usually write to the original copy)
- Switching the future access of an application from the original copy to the shadow copy by exchanging the names of the data sets, and then allowing read/write access again

If you specify SHRLEVEL CHANGE and FASTSWITCH NO, pending definition changes are not materialized.

If you specify CHANGE, you cannot specify the following parameters:

- LOG. Reorganization with CHANGE always creates an image copy and always refrains from logging records during reloading.
- UNLOAD PAUSE, UNLOAD ONLY, or UNLOAD EXTERNAL. Reorganization with CHANGE always uses UNLOAD CONTINUE, which is the default value. (You can explicitly specify UNLOAD CONTINUE or none of the UNLOAD options, but you cannot specify UNLOAD PAUSE, UNLOAD ONLY, or UNLOAD EXTERNAL.)

Performing REORG TABLESPACE PART SHRLEVEL CHANGE with the REORG_PART_SORT_NPSI subsystem parameter enabled might require larger sort work data sets because of the increased number of keys sorted for nonpartitioned secondary indexes.

Specifying SHRLEVEL REFERENCE or CHANGE on an entire XML partitioned table space converts the XML table space to extended 10-byte format if one of the following is true:

- The UTILITY OBJECT CONVERSION subsystem parameter is set to EXTENDED or NOBASIC.
- The RBALRSN_CONVERSION EXTENDED keywords are specified.

Restrictions:

- You cannot specify SHRLEVEL CHANGE if the table space has the NOT LOGGED attribute, unless the table space is a LOB table space.
- If you specify SHRLEVEL CHANGE in a REORG TABLESPACE control statement that completes the process of recovery to a point in time prior to the materialization of pending definition changes, REORG issues a message, and uses SHRLEVEL REFERENCE.

DEADLINE

Specifies the deadline for the SWITCH phase to begin. If DB2 estimates that the SWITCH phase will not begin by the deadline, DB2 issues the messages that the **DISPLAY UTILITY** command would issue and then terminates the reorganization.

The final result and all the timestamp calculation of DEADLINE will be in TIMESTAMP(6).

If REORG SHRLEVEL REFERENCE or SHRLEVEL CHANGE terminates because of a DEADLINE specification, DB2 issues message DSNU374I with reason code 2 but does not set a restrictive status.

NONE

Specifies that a deadline by which the SWITCH phase of log processing must begin does not exist.

timestamp

Specifies the deadline for the SWITCH phase of log processing to begin. This deadline must not have already occurred when REORG is executed.

labeled-duration-expression

Calculates the deadline for the SWITCH phase of log processing to begin. The calculation is based on either CURRENT TIMESTAMP or CURRENT DATE. You can add or subtract one or more*constant* value to specify the deadline. This deadline must not have already occurred when REORG is executed. CURRENT TIMESTAMP and CURRENT DATE are evaluated once, when the REORG statement is first processed. If a list of objects is specified, the same value will be in effect for all objects in the list.

CURRENT_DATE

Specifies that the deadline is to be calculated based on the CURRENT DATE.

CURRENT_TIMESTAMP

Specifies that the deadline is to be calculated based on the CURRENT TIMESTAMP.

WITH TIME ZONE

Specifies that the CURRENT TIMESTAMP is compared with the time zone column. The timestamp precision of the special register CURRENT TIMESTAMP should be the same as the column timestamp precision. Otherwise the default timestamp precision is used. The time

zone of CURRENT TIMESTAMP is the value of special register CURRENT TIMEZONE. The comparison is done by comparing the UTC portion of the timestamp.

constant
Indicates a unit of time and is followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS. The singular form of these words is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, MICROSECOND.

DRAIN_WAIT *integer*
Specifies the number of seconds that the utility waits when draining the table space or index. The specified time is the aggregate time for objects that are to be reorganized. This value overrides the values that are specified by IRLMRWT and UTIMOUT. Valid values for *integer* are from 0 to 1800. If the keyword is omitted or if a value of 0 is specified, the utility uses the value of the lock timeout system parameter IRLMRWT.

RETRY *integer*
Specifies the maximum number of retries that REORG is to attempt. Valid values for *integer* are from 0 to 255.

Specifying RETRY can lead to increased processing costs and can result in multiple or extended periods of read-only access. For example, when you specify RETRY and SHRLEVEL CHANGE, the size of the copy that is taken by REORG might increase.

The default value is the value of the **UTIMOUT** subsystem parameter.

RETRY_DELAY *integer*
Specifies the minimum duration, in seconds, between retries. Valid values for *integer* are from 1 to 1800.

If you do not specify RETRY_DELAY, REORG TABLESPACE uses the smaller of the following two values:

- DRAIN_WAIT value × RETRY value
- DRAIN_WAIT value × 10

MAPPINGTABLE *table-name*
Specifies the name of the mapping table that REORG TABLESPACE is to use to map between the RIDs of data records in the original copy of the area and the corresponding RIDs in the shadow copy. Enclose the table name in quotation marks if the name contains a blank. If a mapping table is required, and one is not specified, REORG will create it.

MAPPINGDATABASE *database-name*
Specifies the database in which REORG implicitly creates the mapping table and index objects. This keyword overrides the subsystem parameter value in REORG_MAPPING_DATABASE. The value cannot be DSNDB01, DSNDB06, DSNDB07, implicit database, and work file or temporary database.

MAXRO *integer*
Specifies the maximum amount of time for the last iteration of log processing. During that iteration, applications have read-only access. MAXRO is a log phase parameter. If MAXRO is specified when a log phase is not needed, an error message is issued.

The actual execution time of the last iteration might exceed the specified value for MAXRO.

The **ALTER UTILITY** command can change the value of MAXRO.

The default value is the **RETRY_DELAY** default value.

integer
integer is the number of seconds. Specifying a small positive value reduces the length of the period of read-only access, but it might increase the elapsed time for REORG to complete. If you specify a huge positive value, the second iteration of log processing is probably the last iteration.

DEFER
Specifies that the iterations of log processing with read-write access can continue indefinitely. REORG never begins the final iteration with read-only access, unless you change the MAXRO value with **ALTER UTILITY**.

If you specify DEFER, you should also specify LONGLOG CONTINUE.

If you specify DEFER, and DB2 determines that the actual time for an iteration and the estimated time for the next iteration are both less than 5 seconds, DB2 adds a 5 second pause to the next iteration. This pause reduces consumption of processor time. The first time this situation occurs for a given execution of REORG, DB2 sends message DSNU362I to the console. The message states that the number of log records that must be processed is small and that the pause occurs. To change the MAXRO value and thus cause REORG to finish, execute the **ALTER UTILITY** command. DB2 adds the pause whenever the situation occurs; however, DB2 sends the message only if 30 minutes have elapsed since the last message was sent for a given execution of REORG.

DRAIN
Specifies drain behavior at the end of the log phase after the MAXRO threshold is reached and when the last iteration of the log is to be applied. DRAIN is a log phase parameter. If DRAIN is specified when a log phase is not needed, an error message is issued.

WRITERS
Specifies that DB2 drains only the writers during the log phase after the MAXRO threshold is reached and then issues DRAIN ALL on entering the switch phase.

| **ALL**
Specifies the current default action, in which DB2 is to drain all readers and writers during the log phase, after the MAXRO threshold is reached.

Consider specifying DRAIN ALL if the following conditions are both true:

- SQL update activity is high during the log phase.
- The default behavior results in a large number of -911 SQL error messages.

Related information:

"Claim classes that REORG TABLESPACE drains" on page 613

LONGLOG
Specifies the action that DB2 is to perform, after sending a message to the console, if the number of records that the next iteration of logging is to process is not sufficiently lower than the number that the previous iterations processed. This situation means that the reading of the log by the REORG TABLESPACE utility is not being done at the same time as the writing of the application

log.LONGLOG is a log phase parameter. If LONGLOG is specified when a log phase is not needed, an error message is issued.

CONTINUE
Specifies that until the time on the JOB statement expires, DB2 is to continue performing reorganization, including iterations of log processing, if the estimated time to perform an iteration exceeds the time that is specified for MAXRO.

A value of DEFER for MAXRO and a value of CONTINUE for LONGLOG together mean that REORG is to continue allowing access to the original copy of the area that is being reorganized and does not switch to the shadow copy. The user can execute the ALTER UTILITY command with a large value for MAXRO to initiate switching.

TERM
Specifies that DB2 is to terminate the reorganization after the delay that is specified by the DELAY parameter.

DRAIN
Specifies that DB2 is to drain the write claim class after the delay that is specified by the DELAY parameter. This action forces the final iteration of log processing to occur. DRAIN is a log phase parameter. If DRAIN is specified when a log phase is not needed, an error message is issued.

DELAY *integer*
Specifies the minimum interval between the time that REORG sends the LONGLOG message to the console and the time that REORG performs the action that is specified by the LONGLOG parameter. DELAY is a log phase parameter. If DELAY is specified when a log phase is not needed, an error message is issued.

integer is the number of seconds.

The default value is **1200**.

TIMEOUT
Specifies the action that is to be taken if the REORG utility gets a timeout condition while trying to drain an object in either the log or switch phases.

TERM
Indicates that DB2 is to behave as follows if you specify the TERM option and a timeout condition occurs:

1. DB2 issues an implicit TERM UTILITY command, causing the utility to end with a return code 8.
2. DB2 issues the DSNU590I and DSNU170I messages.
3. DB2 leaves the object in a read-write state.

ABEND
Indicates that, if a timeout condition occurs, DB2 takes one of the following actions:

- If DRAIN ALL is specified, DB2 leaves the object in a UTRW state.
- If DRAIN WRITERS is specified or used by default:
  - If the failure occurs when there is a write drain lock on the object, DB2 leaves the object in a UTRW state.
  - If the failure occurs when there is a read drain lock on the object, DB2 leaves the object in a UTRO state.

LOGRANGES
Specifies whether REORG is to use SYSLGRNX information for the LOG phase.

YES
REORG uses SYSLGRNX information for the LOG phase whenever possible. This option is the default behavior.

NO REORG does not use SYSLGRNX information for the LOG phase. This option can cause REORG to run much longer. In a data sharing environment this option can result in the merging of all logs from all members. This option is feasible when there is a known integrity issue with SYSLGRNX entries and performance problems in accessing SYSLGRNX for log read determination.

DRAIN_ALLPARTS
Specifies the action to take during a part level REORG TABLESPACE SHRLEVEL REFERENCE or CHANGE when a nonpartitioned secondary index is defined on a partitioned table space.

NO REORG drains the target data partitions serially followed by the nonpartitioned secondary indexes. This option is the default behavior.

YES
REORG obtains the table space level drain on the entire partitioned table space first, before draining the target data partitions and the indexes. This option can provide relief by eliminating drain timeout or deadlocks caused by the reverse order of object-draining by REORG and object-claiming by DML statements.

SWITCHTIME
Specifies the time for the final log iteration of the LOG phase to begin. The final result and all of the time stamp calculations of SWITCHTIME are in TIMESTAMP(6). This keyword can be specified with the MAXRO keyword. If MAXRO DEFER is not specified, REORG enters the final log iteration of the LOG phase before the specified SWITCHTIME value if the specified or defaulted MAXRO criteria is met. When MAXRO DEFER is specified, REORG does not attempt to enterto the final log iteration until the specified SWITCHTIME is met or affected by an external ALTER UTILITY command in the changing of its MAXRO value.

NONE
Does not specify a time for the final log iteration of the LOG phase. This option is the default behavior.

timestamp
Specifies the time that the final log iteration of the LOG phase is to begin. This time must not have already occurred when REORG is run.

labeled-duration-expression
Calculates the time for the final log iteration of LOG phase is to begin. The calculation is based on either CURRENT TIMESTAMP or CURRENT DATE. You can add or subtract one or more constant values to specify the switch time. This switch time must not have already occurred when REORG is run. CURRENT TIMESTAMP and CURRENT DATE are evaluated once, when the REORG statement is first processed. If a list of objects is specified, the same value is in effect for all objects in the list.

CURRENT_DATE
Specifies that the deadline is to be calculated based on the CURRENT DATE.

CURRENT_TIMESTAMP
Specifies that the deadline is to be calculated based on the CURRENT TIMESTAMP.

WITH TIME ZONE
Specifies that the CURRENT TIMESTAMP is compared with the time zone column. The time stamp precision of the special register CURRENT TIMESTAMP should be the same as the column time stamp precision. Otherwise, the default time stamp precision is used. The time zone of CURRENT TIMESTAMP is the value of special register CURRENT TIMEZONE. The comparison is done by comparing the Coordinated Universal Time portion of the time stamp.

constant
Indicates a unit of time and is followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS. The singular form of these words is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, MICROSECOND.

NEWMAXRO
Specifies the maximum amount of time for the last log iteration after SWITCHTIME is met. The SWITCHTIME keyword must also be specified. This value overrides the existing MAXRO parameter that is specified. The default is NONE.

NONE
Specifies that when the specified SWITCHTIME is met, REORG proceeds to the last log iteration without taking log processing time in to consideration. Specifying NONE will result in REORG entering the last log iteration almost immediately at or after the specified SWITCHTIME. This option is the default.

integer
integer is the number of seconds. Specifying a small positive value reduces the length of the period of read-only access, but it might increase the elapsed time for REORG to complete. Specifying a large positive value probably ensures that REORG will enter the last log iteration almost immediately at or after the specified SWITCHTIME.

FORCE
Specifies the action to be taken when the utility is draining the table space.

When REORG FORCE is canceling the threads, it performs a soft cancel similar to the cancel that the CANCEL THREAD does.

NONE
Specifies that no action is taken when REORG performs drain. The REORG utility waits for the claimers to commit. The utility will timeout or restart when the drain fails, as determined by existing conditions.

READERS
Specifies that read claimers are canceled when REORG is requesting a drain all on the last RETRY processing.

ALL
Specifies that both read and write claimers are canceled when REORG is requesting a drain all or drain writers on the last RETRY processing.

SORTNPSI
Specifies when REORG TABLESPACE PART is to sort all keys of a non-partitioned secondary index. This keyword is ignored for a REORG that is not partition-level or a REORG without non-partitioned secondary indexes. If SORTNPSI is not specified, the value is determined by REORG_PART_SORT_NPSI subsystem parameter. The benefit of sorting all

keys of a non-partitioned secondary index increases as the ratio of data that is reorganized to total data in the table space increases.

The default value is the value of subsystem parameter REORG_PART_SORT_NPSI.

When SORTNPSI AUTO or SORTNPSI YES is specified, or when the REORG_PART_SORT_NPSI subsystem parameter is set to AUTO or YES, REORG TABLESPACE PART can collect statistics for a non-partitioned secondary index when the STATISTICS INDEX keywords are also specified. However, in some of these cases, REORG does not collect statistics. This situation occurs if REORG chooses not to sort all of the nonpartitioned index keys, because the amount of data to reorganize or the sizes of objects exceeded internal thresholds.

AUTO
Specifies that if sorting all keys of the non-partitioned secondary indexes improves the elapsed time and CPU performance, all keys are sorted.

YES
Specifies that if sorting all keys of the non-partitioned secondary indexes improves the elapsed time, all keys are sorted.

NO Specifies that only keys of the non-partitioned secondary indexes that are in the scope of the REORG are sorted.

AUX
Specifies that the LOB table spaces associated with the partitions of a partitioned table space being reorganized by the REORG utility are also reorganized.

NO Indicates that a reorganization is performed on the base table space, but the associated LOB table spaces are not reorganized.

If the AUX keyword is omitted, AUX NO is the default unless one or more of the cases described in AUX YES are true.

AUX NO is ignored when the target table space has pending definition changes to convert it from a simple or segmented table space to a partition-by-growth table space. In this case, AUX YES is in effect.

LOG NO cannot be specified for a REORG operation that completes recovery to a point in time before pending definition changes were materialized, if there were pending definition changes on the base table space and on the LOB table space. REORG must be run on the LOB table space first, and then run on the base table space. When REORG is run on the base table space, AUX YES is in effect.

For a table with LOB columns that are affected by pending alter limit keys, a REORG job with AUX NO does not materialize the limit key changes. In this case, you need to specify AUX YES for those changes to be materialized.

YES
Indicates that LOB table spaces associated with the base partitioned table space are reorganized when the base table space is reorganized. Partitions of the associated table spaces are also reorganized.

If the AUX keyword is omitted, in the following cases, AUX YES is the default:

- REORG TABLESPACE of a partition-by-growth base table space with one or more LOB columns, where the table space has a MAXPARTITIONS value that is greater than one.
- REORG TABLESPACE SHRLEVEL REFERENCE REBALANCE of a partitioned base table space with one or more LOB columns.
- REORG TABLESPACE is run against directory table space SPT01, and SPT01 is in the REORP or AREOR state. In this case, AUX YES is always used.
- REORG TABLESPACE of a partitioned base table space with one or more LOB columns where one or more partition ranges are in REORG pending state because an ALTER TABLE PARTITION command has been issued to change the partition key boundaries.
- REORG TABLESPACE DISCARD of a table in a partitioned table space with one or more LOB columns.

When AUX YES is implicitly or explicitly specified, and the COPYDDN parameter specifies a TEMPLATE utility control statement with the &SN. or &TS. variables without substring notation on them, REORG takes the following actions for the LOB table spaces:

- Creates inline image copies
- Resets COPY-pending status

When AUX YES is implicitly or explicitly specified and templates are specified, make sure that those templates generate unique data set names for the auxiliary table spaces that are being reorganized. Make sure that you account for auxiliary table spaces that are included in any specified LISTDEF lists.

When AUX YES is implicitly or explicitly specified, and FlashCopy image copies are taken as part of REORG, REORG produces image copies for all of the LOB table spaces that are being reorganized.

Restrictions: When REORG with AUX YES is run on a partition-by-growth table space with LOB columns, the following restrictions apply:

- If REORG generates a new partition during the LOG phase, REORG cannot create inline image copies for LOB table spaces for the newly created partition. REORG leaves the LOB tables space in COPY-pending status and issues a warning message.
- If you specify that REORG is to create inline copies and use a template for the copies, do not use the STACK YES option for the template. If you do so, REORG fails, because the base and auxiliary table spaces cannot be stacked on the same tape volume. If you need to use a template with the STACK YES option, specify AUX NO on the REORG statement and then reorganize and copy the auxiliary table spaces separately.

Recommendation: After running REORG with AUX YES on a partition-by-growth table space with LOB columns, run COPY with SCOPE PENDING and a LISTDEF utility control statement that includes the LOB table spaces. Doing so creates a recovery base and removes COPY-pending status for the LOB table spaces.

FASTSWITCH

Specifies which switch methodology is to be used for a given reorganization.

When FASTSWITCH is specified with SHRLEVEL CHANGE or SHRLEVEL REFERENCE, the UTILITY_OBJECT_CONVERSION subsystem parameter setting NONE, BASIC, or EXTENDED is accepted.

YES
Enables the SWITCH phase to use the FASTSWITCH methodology. This option is not allowed for the catalog (DSNDB06) or directory (DSNDB01).

NO Causes the SWITCH phase to use IDCAMS RENAME.

When FASTSWITCH NO is specified with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, pending definition changes are not materialized.

OFFPOSLIMIT *integer*

The OFFPOSLIMIT option is deprecated, and the alternative is running DSNACCOX.Indicates that the specified value is to be compared to the value that DB2 calculates for the explicit clustering indexes of every table in the specified partitions that are in SYSIBM.SYSINDEXPART. The calculation is computed as follows:

```
(NEAROFFPOSF + FAROFFPOSF) × 100 / CARDF
```

Alternatively, DB2 checks the values in SYSINDEXPART for a single nonpartitioned table space, or for each partition if you specified an entire partitioned table space as the target object. If at least one calculated value exceeds the OFFPOSLIMIT value, REORG is performed or recommended. This option is valid for non-LOB table spaces only.

integer is the value that is to be compared and can range from 0 to 65535.

The default value is **10**.

INDREFLIMIT *integer*

The INDREFLIMIT option is deprecated, and the alternative is running DSNACCOX.Indicates that the specified value is to be compared to the value that DB2 calculates for the specified partitions in SYSIBM.SYSTABLEPART for the specified table space. The calculation is computed as follows:

```
(NEARINDREF + FARINDREF) × 100 / CARDF
```

Alternatively, DB2 checks the values in SYSTABLEPART for a single nonpartitioned table space, or for each partition if you specified an entire partitioned table space as the target object. If at least one calculated value exceeds the calculated value exceeds the INDREFLIMIT value, REORG is performed or recommended. This option is valid for non-LOB table spaces only.

integer is the value that is to be compared and can range from 0 to 65535.

The default value is **10**.

REPORTONLY

The REPORTONLY option is deprecated, and the alternative is running DSNACCOX.Specifies that REORG is only to be recommended, not performed. REORG produces a report with one of the following return codes:

1 No limit met; no REORG is to be performed or recommended.
2 REORG is to be performed or recommended.

UNLOAD
Specifies whether the utility job is to continue processing or end after the data is unloaded. Unless you specify UNLOAD EXTERNAL, data can be reloaded

only into the same table and table space (as defined in the DB2 catalog) on the same subsystem. (This does not preclude VSAM redefinition during UNLOAD PAUSE.)

You must specify UNLOAD ONLY for the data set to be in a format that is compatible with the FORMAT UNLOAD option of LOAD. However, with LOAD, you can load the data only into the same object from which it is unloaded.

This option is valid for non-LOB table spaces only.

You must specify UNLOAD EXTERNAL for the data set to be in a format that is usable by LOAD without the FORMAT UNLOAD option. With UNLOAD EXTERNAL, you can load the data into any table with compatible columns in any table space on any DB2 subsystem.

CONTINUE

Specifies that, after the data has been unloaded, the utility is to continue processing. An edit routine can be called to decode a previously encoded data row if an index key requires extraction from that row.

If you specify DISCARD, rows are decompressed and edit routines are decoded. If you also specify DISCARD to a file, rows are decoded by field procedure, and the following columns are converted to DB2 external format:

- SMALLINT
- INTEGER
- FLOAT
- DECIMAL
- TIME
- TIMESTAMP

Otherwise, edit routines or field procedures are bypassed on both the UNLOAD and RELOAD phases for table spaces. Validation procedures are not invoked during either phase.

PAUSE

The UNLOAD PAUSE option is deprecated, and the alternative is running the UNLOAD utility.Specifies that, after the data has been unloaded, processing is to end. The utility stops and the RELOAD status is stored in SYSIBM.SYSUTIL so that processing can be restarted with RELOAD RESTART(PHASE).

This option is useful if you want to redefine data sets during reorganization. For example, with a user-defined data set, you can:

- Run REORG with the UNLOAD PAUSE option.
- Redefine the data set by using Access Method Services.
- Restart REORG by resubmitting the previous job and specifying RESTART(PHASE).

However, you cannot use UNLOAD PAUSE if you specify the LIST option.

ONLY

The UNLOAD ONLY option is deprecated, and the alternative is running the UNLOAD utility.Specifies that, after the data has been unloaded, the utility job ends and the status that corresponds to this utility ID is removed from SYSIBM.SYSUTIL.

If you specify UNLOAD ONLY with REORG TABLESPACE, any edit routine or field procedure is executed during record retrieval in the unload phase.

This option is not allowed for any table space in DSNDB01 or DSNDB06.

The DISCARD and WHEN options are not allowed with UNLOAD ONLY.

EXTERNAL

The UNLOAD EXTERNAL option is deprecated, and the alternative is running the UNLOAD utility.Specifies that, after the data has been unloaded, the utility job is to end and the status that corresponds to this utility ID is removed.

The UNLOAD utility has more functions. If you specify UNLOAD EXTERNAL with REORG TABLESPACE, rows are decompressed, edit routines are decoded, field procedures are decoded, and SMALLINT, INTEGER, FLOAT, DECIMAL, DATE, TIME, and TIMESTAMP columns are converted to DB2 external format. Validation procedures are not invoked.

Do not specify the EXTERNAL keyword for:

- Table spaces in DSNDB01 or DSNDB06
- Base tables with XML columns
- XML table spaces

The DISCARD option is not allowed with UNLOAD EXTERNAL.

NOPAD

Specifies whether the variable-length columns in the unloaded or discarded records are to occupy the actual data length without additional padding. The unloaded records can have varying lengths.

YES
Specifies that the variable-length columns in the unloaded or discarded records are to occupy the actual data length without additional padding.

NO Specifies that REORG processing pads variable-length columns in the unloaded or discarded records to their maximum length; the unloaded or discarded records have equal lengths for each table.

You can specify the NOPAD option only with UNLOAD EXTERNAL or with UNLOAD DISCARD.

Although the LOAD utility processes records with variable-length columns that were unloaded or discarded with the NOPAD option, these records cannot be processed by applications that process only fields that are in fixed positions.

For the generated LOAD statement to provide a NULLIF condition for fields that are not in a fixed position, DB2 generates an input field definition with a name in the form of DSN_NULL_IND_*nnnnn*, where *nnnnn* is the number of the associated column.

For example, the LOAD statement that is generated for the EMP sample table looks similar to the LOAD statement that is in the following figure:

```
LOAD DATA INDDN SYSREC   LOG NO  RESUME YES
 EBCDIC CCSID(00500,00000,00000)
 INTO TABLE "DSN8B10 "."EMP               "
 WHEN(00004:00005 = X'0012')
 ( "EMPNO             " POSITION(00007:00012) CHAR(006)
 , "FIRSTNME          " POSITION(00013)       VARCHAR
```

```
  , "MIDINIT           " POSITION(*)           CHAR(001)
  , "LASTNAME          " POSITION(*)           VARCHAR
  ,  DSN_NULL_IND_00005  POSITION(*)           CHAR(1)
  , "WORKDEPT          " POSITION(*)           CHAR(003)
                           NULLIF(DSN_NULL_IND_00005)=X'FF'
  ,  DSN_NULL_IND_00006  POSITION(*)           CHAR(1)
  , "PHONENO           " POSITION(*)           CHAR(004)
                           NULLIF(DSN_NULL_IND_00006)=X'FF'
  ,  DSN_NULL_IND_00007  POSITION(*)           CHAR(1)
  , "HIREDATE          " POSITION(*)           DATE EXTERNAL
                           NULLIF(DSN_NULL_IND_00007)=X'FF'
  ,  DSN_NULL_IND_00008  POSITION(*)           CHAR(1)
  , "JOB               " POSITION(*)           CHAR(008)
                           NULLIF(DSN_NULL_IND_00008)=X'FF'
  ,  DSN_NULL_IND_00009  POSITION(*)           CHAR(1)
  , "EDLEVEL           " POSITION(*)           SMALLINT
                           NULLIF(DSN_NULL_IND_00009)=X'FF'
  ,  DSN_NULL_IND_00010  POSITION(*)           CHAR(1)
  , "SEX               " POSITION(*)           CHAR(001)
                           NULLIF(DSN_NULL_IND_00010)=X'FF'
  ,  DSN_NULL_IND_00011  POSITION(*)           CHAR(1)
  , "BIRTHDATE         " POSITION(*)           DATE EXTERNAL
                           NULLIF(DSN_NULL_IND_00011)=X'FF'
  ,  DSN_NULL_IND_00012  POSITION(*)           CHAR(1)
  , "SALARY            " POSITION(*)           DECIMAL
                           NULLIF(DSN_NULL_IND_00012)=X'FF'
  ,  DSN_NULL_IND_00013  POSITION(*)           CHAR(1)
  , "BONUS             " POSITION(*)           DECIMAL
                           NULLIF(DSN_NULL_IND_00013)=X'FF'
  ,  DSN_NULL_IND_00014  POSITION(*)           CHAR(1)
  , "COMM              " POSITION(*)           DECIMAL
                           NULLIF(DSN_NULL_IND_00014)=X'FF'
  )
```

Figure 65. Sample LOAD statement generated by REORG TABLESPACE with the NOPAD keyword

FROM TABLE

Specifies the tables that are to be reorganized. The table space that is specified in REORG TABLESPACE can store more than one table. All tables that are specified by FROM TABLE statements must be unique. All tables are unloaded for UNLOAD EXTERNAL, and all tables might be subject to DISCARD. If you specify UNLOAD EXTERNAL and want to limit which tables and rows are unloaded, specify FROM TABLE with the WHEN option. If you specify DISCARD, you must qualify the rows that you want to discard by specifying FROM TABLE with the WHEN option.

Do not specify FROM TABLE with REORG TABLESPACE LIST.

table-name

Specifies the name of the table that is to be qualified by the following WHEN clause. The table must be described in the catalog and must not be a catalog table. If the table name is not qualified by a schema name, the authorization ID of the person who invokes the utility job step is used as the schema qualifier of the table name. Enclose the table name in quotation marks if the name contains a blank.

WHEN

Indicates which records in the table space are to be unloaded (for UNLOAD EXTERNAL) or discarded (for DISCARD). If you do not specify a WHEN clause for a table in the table space, all of the records are unloaded (for UNLOAD EXTERNAL), or none of the records is discarded (for DISCARD).

The option following WHEN describes the conditions for UNLOAD or DISCARD of records from a table and must be enclosed in parentheses.

selection condition
Specifies a condition that is true, false, or unknown about a specific row. When the condition is true, the row qualifies for UNLOAD or DISCARD. When the condition is false or unknown, the row does not qualify.

A selection condition consists of at least one predicate and any *logical operators* (AND, OR, NOT). The result of a selection condition is derived by applying the specified *logical operators* to the result of each specified predicate. If logical operators are not specified, the result of the selection condition is the result of the specified predicate.

Selection conditions within parentheses are evaluated first. If the order of evaluation is not specified by parentheses, AND is applied before OR.

If the control statement is in the same encoding scheme as the input data, you can code character constants in the control statement. Otherwise, if the control statement is not in the same encoding scheme as the input data, you must code the condition with hexadecimal constants. If the target table is ASCII, any character constants must be specified in hexadecimal. For example, if the table space is in EBCDIC and the control statement is in UTF-8, use (1:1)=X'F1' in the condition rather than (1:1)='1'.

Restriction: REORG TABLESPACE cannot filter rows that contain encrypted data.

predicate
A *predicate* specifies a condition that is true, false, or unknown about a given row or group.

basic predicate
Specifies the comparison of a column with a constant. If the value of the column is null, the result of the predicate is unknown. Otherwise, the result of the predicate is true or false.

Predicate
Is true if and only if

column-name **= constant**
The column is equal to the constant or labeled duration expression.

column-name **< > constant**
The column is not equal to the constant or labeled duration expression.

column-name **> constant**
The column is greater than the constant or labeled duration expression.

column-name **< constant**
The column is less than the constant or labeled duration expression.

column-name **> = constant**
The column is greater than or equal to the constant or labeled duration expression.

column-name **< = constant**
The column is less than or equal to the constant or labeled duration expression.

Comparison operators: The following forms of the comparison operators are also supported in basic and quantified predicates: !=, !<, and !>, where ! means not. In addition, in code pages 437, 819, and 850, the forms ¬=, ¬<, and ¬> are supported. All these product-specific forms of the comparison operators are intended only to support existing REORG statements that use these operators and are not recommended for use in new REORG statements.

A not sign (¬), or the character that must be used in its place in certain countries, can cause parsing errors in statements that are passed from one DBMS to another. The problem occurs if the statement undergoes character conversion with certain combinations of source and target CCSIDs. To avoid this problem, substitute an equivalent operator for any operator that includes a not sign. For example, substitute '< >' for '¬=', '<=' for '¬>', and '>=' for '¬<'.

BETWEEN predicate
Indicates whether a given value is between two other given values that are specified in ascending order. Each of the predicate's two forms (BETWEEN and NOT BETWEEN) has an equivalent search condition, as shown in the following table. If relevant, the table also shows any equivalent predicates.

Table 79. BETWEEN predicates and their equivalent search conditions

Predicate	Equivalent predicate	Equivalent search condition
column BETWEEN *value1* AND *value2*	None	(*column* >= *value1* AND *column* <= *value2*)
column NOT BETWEEN *value1* AND *value2*	NOT(*column* BETWEEN *value1* AND *value2*)	(*column* < *value1* OR *column* > *value2*)

Note: The values can be constants or labeled duration expressions.

For example, the following predicate is true for any row when salary is greater than or equal to 10 000 and less than or equal to 20 000:

```
SALARY BETWEEN 10000 AND 20000
```

labeled-duration-expression
Specifies an expression that begins with the following special register values:

- CURRENT DATE (CURRENT_DATE is acceptable.)
- CURRENT TIMESTAMP (CURRENT_TIMESTAMP is acceptable.)

Optionally, the expression contains the arithmetic operations of addition or subtraction, expressed by a number followed by one of the seven duration keywords:

- YEARS (or YEAR)
- MONTHS (or MONTH)
- DAYS (or DAY)
- HOURS (or HOUR)
- MINUTES (or MINUTE)
- SECONDS (or SECOND)

- MICROSECONDS (or MICROSECOND)

Utilities evaluate a *labeled-duration-expression* as a timestamp and implicitly perform a conversion to a date if the comparison is with a date column.

Incrementing and decrementing CURRENT DATE: The result of adding a duration to a date, or of subtracting a duration from a date, is itself a date. (For the purposes of this operation, a month denotes the equivalent of a calendar page. Adding months to a date, then, is like turning the pages of a calendar, starting with the page on which the date appears.) The result must fall between the dates January 1, 0001 and December 31, 9999 inclusive.

The following table describes the effects of adding and subtracting years, months, days, and other dates.

Table 80. Effects of adding durations to and subtracting durations from CURRENT DATE

Value that is added or subtracted	Effect
Years	Adding or subtracting a duration of years affects only the year portion of the date. The month is unchanged, as is the day unless the result would be February 29 of a non-leap-year. In this case, the day portion of the result is set to 28.
Months	Adding or subtracting a duration of months affects only months and, if necessary, years. The day portion of the date is unchanged unless that day does not exist in the resulting month. (September 31, for example). In this case the day is set to the last day of the month. Adding a month to a date gives the same day one month later unless that day does not exist in the later month. In that case, the day in the result is set to the last day of the later month. For example, January 28 plus one month gives February 28; one month added to January 29, 30, or 31 results in either February 28 or, for a leap year, February 29. If one or more months is added to a given date and then the same number of months is subtracted from the result, the final date is not necessarily the same as the original date.
Days	Adding or subtracting a duration of days affects the day portion of the date, and potentially the month and year.
Dates	When a positive date duration is added to a date, or a negative date duration is subtracted from a date, the date is incremented by the specified number of years, months, and days. When a positive date duration is subtracted from a date, or a negative date duration is added to a date, the date is decremented by the specified number of days, months, and years.

The order in which labeled date durations are added to and subtracted from dates can affect the results. When you add labeled date durations to a date, specify them in the order of YEARS + MONTHS + DAYS. When you subtract labeled date durations from a date, specify them in the order of DAYS - MONTHS - YEARS. For example, to add one year and one day to a date, specify the following code:

```
CURRENT DATE + 1 YEAR + 1 DAY
```

To subtract one year, one month, and one day from a date, specify the following code:

```
CURRENT DATE - 1 DAY - 1 MONTH - 1 YEAR
```

Incrementing and decrementing timestamps: The result of adding a duration to a timestamp, or of subtracting a duration from a timestamp, is itself a timestamp. Date and time arithmetic is performed as previously defined, except that an overflow or underflow of hours is carried into the date part of the result, which must be within the range of valid dates. For example, if the current date is January 15 and the current time is 20:00, `CURRENT_TIMESTAMP+8 HOURS` yields January 16, 04:00. Likewise, `CURRENT_TIMESTAMP-22 HOURS` yields January 14, 22:00.

IN predicate

Specifies that a value is to be compared with a set of values. In the IN predicate, the second operand is a set of one or more values that are specified by constants. Each of the predicate's two forms (IN and NOT IN) has an equivalent search condition, as shown in the following table.

Table 81. IN predicates and their equivalent search conditions

Predicate	Equivalent search condition
value1 IN (*value1*, *value2*,..., *valuen*)	(*value1* = *value2* OR ... OR *value1* = *valuen*)
value1 NOT IN (*value1*, *value2*,..., *valuen*)	*value1* ¬= *value2* AND ... AND *value1* ¬= *valuen*)

Note: The values can be constants or labeled duration expressions.

For example, the following predicate is true for any row with an employee in department D11, B01, or C01:

```
WORKDEPT IN ('D11', 'B01', 'C01')
```

LIKE predicate

Qualifies strings that have a certain pattern. Specify the pattern by using a string in which the underscore and percent sign characters can be used as wildcard characters. The underscore character (_) represents a single, arbitrary character. The percent sign (%) represents a string of zero or more arbitrary characters.

In this description, let *x* denote the column that is to be tested and *y* denote the pattern in the string constant.

The following rules apply to predicates of the form "*x* LIKE *y*...". If NOT is specified, the result is reversed.

- When *x* or *y* is null, the result of the predicate is unknown.
- When *y* is empty and *x* is not empty, the result of the predicate is false.
- When *x* is empty and *y* is not empty, the result of the predicate is false unless *y* consists only of one or more percent signs.
- When *x* and *y* are both empty, the result of the predicate is true.
- When *x* and *y* are both not null, the result of the predicate is true if *x* matches the pattern in *y* and false if *x* does not match the pattern in *y*.

The pattern string and the string that is to be tested must be of the same type; that is, both *x* and *y* must be character strings, or both *x* and *y* must be graphic strings. When *x* and *y* are graphic strings, a character is a DBCS character. When *x* and *y* are character strings and

x is not mixed data, a character is an SBCS character, and *y* is interpreted as SBCS data regardless of is subtype.

Within the pattern, a percent sign (%) or underscore character (_) can represent the literal occurrence of a percent sign or underscore character. To have a literal meaning, each character must be preceded by an escape character.

The ESCAPE clause designates a single character. You can use that character, and only that character, multiple times within the pattern as an escape character. When the ESCAPE clause is omitted, no character serves as an escape character and percent signs and underscores in the pattern can only be used to represent arbitrary characters; they cannot represent their literal occurrences.

The following rules apply to the use of the ESCAPE clause:

- The ESCAPE clause cannot be used if *x* is mixed data.
- If *x* is a character string, the data type of the string constant must be character string. If *x* is a graphic string, the data type of the string constant must be graphic string. In both cases, the length of the string constant must be 1.
- The pattern must not contain the escape character except when followed by the escape character, '%', or '_'. For example, if '+' is the escape character, any occurrences of '+' other than '++', '+_', or '+%' in the pattern is an error.

When that pattern does not include escape characters, a simple description of its meaning is:

- The underscore character (_) represents a single, arbitrary character.
- The percent sign (%) represents a string of zero or more arbitrary characters.
- Any other character represents a single occurrence of itself.

Strings and patterns:

The string *y* is interpreted as a sequence of the minimum number of substring specifiers, such that each character of *y* is part of exactly one substring specifier. A substring specifier is an underscore, a percent sign, or any non-empty sequence of characters other than an underscore or percent sign.

The string *x* matches the pattern *y* if a partitioning of *x* into substrings exists, such that:

- A substring of *x* is a sequence of zero or more contiguous characters, and each character of *x* is part of exactly one substring.
- If the *n*th substring specifier is an underscore, the *n*th substring of *x* is any single character.
- If the *n*th substring specifier is a percent sign, the *n*th substring of *x* is any sequence of zero or more characters.
- If the *n*th substring specifier is neither an underscore nor a percent sign, the *n*th substring of *x* is equal to that substring specifier and has the same length as that substring specifier.
- The number of substrings of *x* is the same as the number of substring specifiers.

When escape characters are present in the pattern string, an underscore, percent sign, or escape character represents a single occurrence of itself if and only if it is preceded by an odd number of successive escape characters.

The way a pattern is matched to evaluate the LIKE predicate depends on whether blanks at the end of fixed length strings are significant, or if the blanks are ignored. When the LIKE_BLANK_INSIGNIFICANT subsystem parameter is enabled, the LIKE predicate can produce different results.

Mixed-data patterns:

If *x* is mixed data, the pattern is assumed to be mixed data, and its special characters are interpreted as follows:

- A single-byte underscore refers to one single-byte character; a double-byte underscore refers to one double-byte character.
- A percent sign, either single-byte or double-byte, refers to any number of characters of any type, either single-byte or double-byte.
- Redundant shift bytes in *x* or *y* are ignored.

Related information:

LIKE predicate (DB2 SQL)

NULL predicate
Specifies a test for null values.

If the value of the column is null, the result is true. If the value is not null, the result is false. If NOT is specified, the result is reversed.

KEEPDICTIONARY
Prevents REORG TABLESPACE from building a new compression dictionary when unloading the rows. The REORG utility builds the compression dictionary during the UNLOAD process. This dictionary is then used during the RELOAD phase to compress the data.

The efficiency of REORG increases with the KEEPDICTIONARY option for the following reasons:

- The processing cost of building the compression dictionary is eliminated.
- Existing compressed rows do not need to be compressed again.
- Existing compressed rows do not need to be expanded, unless indexes require it or SORTDATA is used.

Possible reasons for not specifying KEEPDICTIONARY are:

- If the data has changed significantly since the last dictionary was built, rebuilding the dictionary might save a significant amount of space.
- If the current dictionary was built either by the LOAD utility or automatically by DB2 based on records that have been inserted over time, rebuilding the dictionary by using REORG might produce a better compression dictionary.
- If the data is being converted from basic row format to reordered row format, REORG builds a new dictionary for the new format. DB2 ignores the KEEPDICTIONARY option if the REORG utility changes the table space from basic row format to reordered row format.

- If REORG is materializing a pending alter of the buffer pool, REORG builds a new dictionary. DB2 ignores the KEEPDICTIONARY option if REORG is materializing a buffer pool change.

KEEPDICTIONARY is valid only if a compression dictionary exists and the table space or partition that is being reorganized has the COMPRESS YES attribute. If a dictionary does not exist, one is built, a warning message is issued, and all the records are compressed.

Messages DSNU234I and DSNU244I, which show compression statistics, are not issued when you specify REORG UNLOAD CONTINUE KEEPDICTIONARY or REORG UNLOAD PAUSE KEEPDICTIONARY.

REORG ignores the KEEPDICTIONARY option if a partition that is being reorganized is in REORG-pending status.

Note: You must use KEEPDICTIONARY to ensure that the compression dictionary is maintained.

Related information:

"Compressing data by using the LOAD utility" on page 328

STATISTICS

Specifies that statistics for the table space or associated index, or both, are to be gathered; the statistics are reported or stored in the DB2 catalog. If statistics are collected with the default options, only the statistics for the table space are updated.

If you specify a table space partition or a range of partitions along with the STATISTICS keyword, DB2 collects statistics only for the specified table space partitions. This option is valid for non-LOB table spaces only.

If you specify a base table space with the STATISTICS keyword, DB2 does not gather statistics for the related XML table space or its indexes.

When SORTNPSI AUTO or SORTNPSI YES is specified, or when the REORG_PART_SORT_NPSI subsystem parameter is set to AUTO or YES, REORG TABLESPACE PART can collect statistics for a non-partitioned secondary index when the STATISTICS INDEX keywords are also specified. However, in some of these cases, REORG does not collect statistics. This situation occurs if REORG chooses not to sort all of the nonpartitioned index keys, because the amount of data to reorganize or the sizes of objects exceeded internal thresholds.

Restrictions:

- If you specify STATISTICS for encrypted data, DB2 might not provide useful statistics on this data.
- You cannot specify STATISTICS if you specify the CLONE keyword.

Statistics for both a table space and its associated indexes are collected and updated in the DB2 catalog when pending definition changes are materialized during REORG TABLESPACE with SHRLEVEL REFERENCE or CHANGE.

If the STATISTICS keyword is specified in the REORG TABLESPACE statement, the options specified overwrite the default options.

If the STATISTICS keyword is not specified in the REORG TABLESPACE statement, the following keywords are used by default:

- STATISTICS TABLE ALL
- INDEX ALL

- UPDATE ALL
- HISTORY ALL

Recommendation: Partition statistics can become obsolete. The partition statistics that can be obsolete are COLGROUP statistics, statistics for key column values in indexes, HISTOGRAM statistics, frequency statistics with NUMCOLS > 1, and statistics for extended indexes where applicable. Run the RUNSTATS utility to collect the partition statistics again.

TABLE
Specifies the table for which column information is to be gathered. All tables must belong to the table space that is specified in the TABLESPACE option.

Do not specify STATISTICS TABLE *table-name* with REORG TABLESPACE LIST. Instead, specify STATISTICS TABLE (ALL).

(ALL)
Specifies that information is to be gathered for all columns of all tables in the table space.

(*table-name***)**
Specifies the tables for which column information is to be gathered. If you omit the qualifier, the user identifier for the utility job is used. Enclose the table name in quotation marks if the name contains a blank.

If you specify more than one table, you must repeat the TABLE option. Multiple TABLE options must be specified entirely before or after any INDEX keyword that may also be specified. For example, the INDEX keyword may not be specified between any two TABLE keywords.

SAMPLE *integer*
Indicates the percentage of rows to be sampled when collecting statistics on non-leading-indexed columns of an index or non-indexed columns. You can specify any value from 1 through 100.

The default value is **25**. The SAMPLE option is not allowed for LOB table spaces.

COLUMN
Specifies columns for which column information is to be gathered.

You can specify this option only if you specify a particular table for which statistics are to be gathered (TABLE (*table-name*)). If you specify particular tables and do not specify the COLUMN option, the default, COLUMN(ALL), is used. If you do not specify a particular table when using the TABLE option, you cannot specify the COLUMN option; however, COLUMN(ALL) is assumed.

(ALL)
Specifies that statistics are to be gathered for all columns in the table.

(column-name, ...)
Specifies the columns for which statistics are to be gathered.

You can specify a list of column names; the maximum is 10. If you specify more than one column, separate each name with a comma.

INDEX
Specifies indexes for which information is to be gathered. Column information is gathered for the first column of the index. All the indexes must be associated with the same table space, which must be the table space that is specified in the TABLESPACE option.

Do not specify STATISTICS INDEX *index-name* with REORG TABLESPACE LIST. Instead, specify STATISTICS INDEX (ALL).

(ALL)
Specifies that the column information is to be gathered for all indexes that are defined on tables that are contained in the table space.

(*index-name***)**
Specifies the indexes for which information is to be gathered. Enclose the index name in quotation marks if the name contains a blank.

COLGROUP (*column-name***, ...)**
Indicates that the specified set of columns are treated as a group. This option enables inline statistics to collect a cardinality value on the specified column group. Inline statistics ignores COLGROUP when processing XML table spaces and indexes.

When you specify the COLGROUP keyword, inline statistics collects correlation statistics for the specified column group. If you want inline statistics to also collect distribution statistics, specify the FREQVAL option with COLGROUP.

(*column-name*, ...) specifies the names of the columns that are part of the column group.

To specify more than one column group, repeat the COLGROUP option.

Restriction: The length of the COLGROUP value cannot exceed the maximum length of the COLVALUE column in the SYSIBM.SYSCOLDIST catalog table.

FREQVAL
Indicates, when specified with the COLGROUP option, that frequency statistics are also to be gathered for the specified group of columns. (COLGROUP indicates that cardinality statistics are gathered.) One group of statistics is gathered for each column. You must specify COUNT integer with COLGROUP FREQVAL. The REORG TABLESPACE utility ignores FREQVAL MOST/LEAST/BOTH when processing XML table spaces and indexes.

COUNT *integer*
Indicates the number of frequently occurring values to be collected from the specified column group. For example, COUNT 20 means that DB2 collects 20 frequently occurring values from the column group. You must specify a value for integer; no default value is assumed. Be careful when specifying a high value for COUNT. Specifying a value of 1000 or more can increase the prepare time for some SQL statements.

MOST
Indicates that the utility is to collect the most frequently occurring values for the specified set of columns when COLGROUP is specified.

BOTH
Indicates that the utility is to collect the most and the least frequently occurring values for the specified set of columns when COLGROUP is specified.

LEAST
Indicates that the utility is to collect the least frequently occurring values for the specified set of columns when COLGROUP is specified.

HISTOGRAM
Indicates, when specified with the COLGROUP option, that histogram statistics

are to be gathered for the specified group of columns. Inline statistics ignore HISTOGRAM when processing XML table spaces and indexes.

Histogram statistics that you collect through REORG TABLESPACE are not the same as histogram statistics that you collect through RUNSTATS. Histogram statistics that you collect with REORG TABLESPACE are only rough estimates. To obtain more exact statistics, use RUNSTATS.

NUMQUANTILES *integer*
Indicates how many quantiles that the utility collects. The integer value must be greater than or equal to one. The number of quantiles that you specify must never exceed the total number of distinct values in the column or the column group. The maximum number of quantiles is 100.

When the NUMQUANTILES keyword is omitted, NUMQUANTILES takes a default value of 100. Based on the number of records in the table, the number of quantiles is readjusted down to an optimal number.

KEYCARD
The KEYCARD option is deprecated in the REORG TABLESPACE control statement and no longer needs to be specified to collect cardinality statistics on the values in the key columns of an index.

When the STATISTICS and INDEX options are specified, the REORG TABLESPACE utility always collects all of the distinct values in all of the 1 to *n* key column combinations in an index.*n* is the number of columns in the index. With the deprecation of KEYCARD, this functionality cannot be disabled.

The REORG TABLESPACE utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when STATISTICS and INDEX are specified.

FREQVAL
Specifies that frequent-value statistics are to be collected. If you specify FREQVAL, you must also specify NUMCOLS and COUNT.

NUMCOLS
Indicates the number of key columns to concatenate together when you collect frequent values from the specified index. Specifying 3 means that DB2 is to collect frequent values on the concatenation of the first three key columns.

The default value is **1**, which means DB2 is to collect frequent values on the first key column of the index.

COUNT
Indicates the number of frequent values that are to be collected. For example, specifying 15 means that DB2 is to collect 15 frequent values from the specified key columns.

The default value is **10**.

HISTOGRAM
Indicates that histogram statistics are requested for the specified index.

NUMCOLS
The number of key columns that are to be concatenated when collecting histogram statistics from the specified index.

NUMQUANTILES
The integer values that follows NUMQUANTILES indicates the number quantiles are requested. The integer value must be greater than or equal to 1.

Histogram statistics can be collected only on keys with the same order if the specified key columns for histogram statistics are of mixed order, a DSNU633I warning message is issued.

Related information:

Histogram statistics (DB2 Performance)

DSNU633I (DB2 Messages)

REPORT
Specifies whether a set of messages is to be generated to report the collected statistics.

NO Indicates that the set of messages is not to be sent as output to SYSPRINT.

YES
Indicates that the set of messages is to be sent as output to SYSPRINT. The generated messages are dependent on the combination of keywords (such as TABLESPACE, INDEX, TABLE, and COLUMN) that are specified with the RUNSTATS utility. However, these messages are **not** dependent on the specification of the UPDATE option. REPORT YES always generates a report of SPACE and ACCESSPATH statistics.

UPDATE
Indicates whether the collected statistics are to be inserted into the catalog tables. UPDATE also allows you to select statistics that are used for access path selection or statistics that are used by database administrators.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that only the catalog table columns that provide statistics that are used for access path selection are to be updated.

SPACE
Indicates that only the catalog table columns that provide statistics to help database administrators assess the status of a particular table space or index are to be updated.

NONE
Indicates that no catalog tables are to be updated with the collected statistics. This option is valid only when REPORT YES is specified.

HISTORY
Specifies that all catalog table inserts or updates to the catalog history tables are to be recorded.

The default value is whatever value is specified in the STATISTICS HISTORY field on panel DSNTIP6.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that only the catalog history table columns that provide statistics that are used for access path selection are to be updated.

SPACE
Indicates that only space-related catalog statistics are to be updated in catalog history tables.

NONE
Indicates that no catalog history tables are to be updated with the collected statistics.

FORCEROLLUP
Specifies whether aggregation or rollup of statistics is to take place when RUNSTATS is executed even if statistics have not been gathered on some partitions; for example, partitions have not had any data loaded. Aggregate statistics are used by the optimizer to select the best access path.

YES
Indicates that forced aggregation or rollup processing is to be done, even though some partitions might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all partitions.

If data is not available for all partitions, DSNU623I message is issued if the installation value for STATISTICS ROLLUP on panel DSNTIP6 is set to NO.

PUNCHDDN *ddname*
Specifies the DD statement for a data set that is to receive the LOAD utility control statements that are generated by REORG TABLESPACE UNLOAD EXTERNAL or REORG TABLESPACE DISCARD FROM TABLE ... WHEN.

ddname is the DD name.

The default value is **SYSPUNCH**.

PUNCHDDN is required if the limit key of the last partition of a partitioned table space has been reduced.

PUNCHDDN is not valid for LOB table spaces.

The PUNCHDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

DISCARDDN *ddname*
Specifies the DD statement for a discard data set, which contains copies of records that meet the DISCARD FROM TABLE ... WHEN specification.

ddname is the DD name.

If you omit the DISCARDDN option, the utility saves discarded records only if a SYSDISC DD statement is in the JCL input.

The default value is **SYSDISC**.

The **DISCARDDN** keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

UNLDDN *ddname*
Specifies the name of the unload data set.

ddname is the DD name of the unload data set.

The default value is **SYSREC**.

The UNLDDN keyword specifies either a DD name or a TEMPLATE name specification from a previous TEMPLATE control statement. If utility processing detects that the specified name is both a DD name in the current job step and a TEMPLATE name, the utility uses the DD name.

SORTDEVT *device-type*
Specifies the device type for temporary data sets that are to be dynamically allocated by the external sort program.

device-type is the device type; it can be any disk device that is acceptable to the DYNALLOC parameter of the SORT or OPTION control statement for the sort program.

If you omit SORTDEVT and require a sort of the index keys, you must provide the DD statements that the sort program needs for the temporary data sets.

SORTDEVT is ignored for the catalog and directory table spaces that are listed in "Reorganizing the catalog and directory" on page 623.

SORTDEVT cannot be used for LOB table spaces.

The utility does not allow a TEMPLATE specification to dynamically allocate sort work data sets. The SORTDEVT keyword controls dynamic allocation of these data sets.

SORTNUM *integer*
Specifies the number of temporary data sets that are to be dynamically allocated for all sorts that REORG performs.

integer is the number of temporary data sets that can range from 2 to 255.

If you omit SORTDEVT, SORTNUM is ignored. If you use SORTDEVT and omit SORTNUM, no value is passed to the sort program. The sort program uses its own SORTNUM default value.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, a total of 24 sort work data sets would be allocated for a job, if the following criteria is true:
- There are three indexes.
- SORTKEYS is specified.
- There are no constraints limiting parallelism.
- SORTNUM is specified as 8.

Each sort work data set consumes both above the line and below the line virtual storage. Therefore, if you specify a value for SORTNUM that is too high, the utility might decrease the degree of parallelism due to virtual storage constraints, and possibly decrease the degree down to one, which would mean no parallelism.

Important: The SORTNUM keyword will not be considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

SORTNUM is ignored for the catalog and directory table spaces listed in "Reorganizing the catalog and directory" on page 623.

PREFORMAT
Specifies that the remaining pages are to be preformatted up to the

high-allocated RBA in the table space and index spaces that are associated with the table space or partitions that are being reorganized. The preformatting occurs after the data is loaded and the indexes are built.

PREFORMAT can operate on an entire table space and its index spaces, or on a partition of a partitioned table space and its corresponding partitioning index space. When AUX YES is specified or accepted as the default, the LOB table spaces and auxiliary indexes that are associated with the base partitions that are being reorganized are also preformatted at the end of the RELOAD phase.

PREFORMAT is ignored if you specify UNLOAD ONLY or UNLOAD EXTERNAL.

ROWFORMAT
Specifies the output row format in the affected table space or partition. This keyword overrides the existing RRF subsystem parameter setting when the keyword is specified. This keyword has no effect on LOB, catalog, directory, XML table spaces, and Universal table spaces that are participating in a CLONE relationship.

BRF
Specifies that the table space or partition that is being reorganized or replaced are to be converted to or remain in basic row format.

RRF
Specifies that the table space or partition that is being reorganized or replaced are to be converted to or remain in reordered row format.

RBALRSN_CONVERSION
Specifies the RBA or LRSN format of the target object after the completion of the REORG utility. If the keyword is not specified, the conversion specified in the UTILITY_OBJECT_CONVERSION subsystem parameter is accepted.

NONE
Specifies that no conversion is performed.

The utility fails if RBALRSN_CONVERSION NONE is specified on a table space that is in basic 6-byte format and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

BASIC
Specifies that if an object is found in extended 10-byte format, it is converted to 6-byte basic format.

The utility fails if RBALRSN_CONVERSION BASIC is specified and the UTILITY_OBJECT_CONVERSION subsystem parameter is set to NOBASIC.

EXTENDED
Specifies that if an object is found in basic 6-byte format, it is converted to 10-byte extended format.

If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to BASIC or EXTENDED, RBALRSN_CONVERSION defaults to the UTILITY_OBJECT_CONVERSION value. If RBALRSN_CONVERSION is not specified, and subsystem parameter UTILITY_OBJECT_CONVERSION is set to NOBASIC, RBALRSN_CONVERSION defaults to EXTENDED.

If a CLONE relationship exists, the page set conversion cannot be performed. For clone relationships, you must drop the clone table, convert the base table to extended 10-byte format, and then re-create the clone table.

If AUX YES is also specified, the LOB table spaces and auxiliary indexes are also converted.

Indexes that are rebuilt during REORG TABLESPACE are converted to the same RBA or LRSN format as the indexed table space. REORG TABLESPACE at the PART level converts corresponding partitions of partitioned indexes. Non partitioned indexes are converted if SHRLEVEL CHANGE or REFERENCE is also specified, or if the entire table space is reorganized with SHRLEVEL NONE.

If the 6-byte RBA or LRSN limit has been reached, you might be unable to perform the first insert or load into an XML table space that has XML versioning and that was created with DEFINE NO and basic 6-byte page format. You can run REORG TABLESPACE on the DEFINE NO XML table space to convert its definition to extended 10-byte page format. The REORG must be done on the entire table space.

DISCARD

Specifies that records that meet the specified WHEN conditions are to be discarded during REORG TABLESPACE UNLOAD CONTINUE or UNLOAD PAUSE. If you specify DISCARDDN or a SYSDISC DD statement in the JCL, discarded records are saved in the associated data set. Otherwise, the utility discards records without saving them in a data set.

You can specify any SHRLEVEL option with DISCARD. However, if you specify SHRLEVEL CHANGE, modifications that are made during the reorganization to data rows that match the discard criteria are not permitted. In this case, REORG TABLESPACE terminates with an error.

If you specify DISCARD, rows are decompressed and edit routines are decoded. If you also specify DISCARD to a file, rows are decoded by field procedure, and the following columns are converted to DB2 external format:

- SMALLINT
- INTEGER
- FLOAT
- DECIMAL
- TIME
- TIMESTAMP

Otherwise, edit routines or field procedures are bypassed on both the UNLOAD and RELOAD phases for table spaces. Validation procedures are not invoked during either phase.

Restrictions: Do not specify DISCARD if any of the following conditions are true:

- The REORG TABLESPACE statement includes the UNLOAD EXTERNAL or UNLOAD ONLY option.
- The table space to be reorganized is any of the following objects:
  - A base table with XML columns
  - An XML table space
  - A base table with LOB columns if the records to be discarded are more than 32 KB and you want to save them in a data set.
  - A system-period temporal table space

Related tasks:

Compressing your data (DB2 Performance)

Related reference:

-CANCEL THREAD (DB2) (DB2 Commands)

Chapter 19, "LISTDEF," on page 221

Chapter 35, "TEMPLATE," on page 789

DB2 Sort

Related information:

DFSORT Application Programming Guide

Before running REORG TABLESPACE

Certain activities might be required before you run the REORG TABLESPACE utility, depending on your situation.

Catalog and directory table spaces

Before you run REORG on a catalog or directory table space, you must take an image copy. For the DSNDB06.SYSTSCPY catalog table space and the DSNDB01.DBD01 and DSNDB01.SYSDBDXA directory table spaces, REORG scans logs to verify that an image copy is available. If the scan of the logs does not find an image copy, DB2 requests archive logs.

Region size

The recommended minimum region size is 4096 KB. Region sizes greater than 32 MB enable increased parallelism for index builds. Data unload and reload parallelism can also benefit from a greater region size value.

Mapping table and SHRLEVEL CHANGE

Before running REORG TABLESPACE with SHRLEVEL CHANGE on a table space with non-LOB data, you can create a mapping table and index for the table space, or allow REORG to create it for you. The table space that contains the mapping table must be segmented or partition-by-growth and cannot be the table space to be reorganized. To create a segmented table space for the mapping table, use a CREATE TABLESPACE statement similar to the following statement:

```
CREATE TABLESPACE table-space-name SEGSIZE integer
```

To create a partition-by-growth table space for the mapping table, use a CREATE TABLESPACE statement similar to the following statement:

```
CREATE TABLESPACE table-space-name MAXPARTITIONS integer
```

The mapping table must have only the columns and the index that are created by the following SQL statements:

```
CREATE TABLE table-name1
 (TYPE        CHAR(1)  NOT NULL,
  SOURCE_RID  CHAR(5)  NOT NULL,
  TARGET_XRID CHAR(9)  NOT NULL,
  LRSN        CHAR(10) NOT NULL);
 CREATE UNIQUE INDEX index-name1 ON table-name1
 (SOURCE_RID ASC, TYPE, TARGET_XRID, LRSN);
```

The size of the table space for the mapping table can be as small as one track. Use the following formula to estimate the minimum number of bytes to allocate for the index on the mapping table:

```
1.1 * Number-of-rows-in-table-space * 27
```

When the LRSN column is CHAR(10):

```
1.1 * Number-of-rows-in-table-space * 31
```

The REORG utility removes all rows from the mapping table when the utility completes.

You must specify the TARGET_XRID column as CHAR(9), even though the RIDs are 5 bytes long.

You must have DELETE, INSERT, and UPDATE authorization on the mapping table.

You can run more than one REORG SHRLEVEL CHANGE job concurrently on separate table spaces. You can also run more than one REORG SHRLEVEL CHANGE job concurrently on different partitions of the same table space, but only if the table space does not have any NPIs. When you run concurrently with other jobs, each REORG job must have a separate mapping table. The mapping tables do not need to reside in separate table spaces. If only one mapping table exists, the REORG jobs must be scheduled to run serially. If more than one REORG job tries to access the same mapping table at the same time, one of the REORG jobs fails.

Recommendation: Consider the following approach to ensure that multiple REORG jobs do not attempt to use the same mapping table concurrently. Assign the same name to the mapping table and the utility ID. Because utility IDs must be unique, this naming decision ensures that the mapping tables are not used by two REORG jobs that run concurrently.

Restart-pending status and SHRLEVEL CHANGE

If you specify SHRLEVEL CHANGE, REORG drains the write claim class near the end of REORG processing. In a data sharing environment, if a data sharing member fails and that member has restart-pending status for a target page set, the drain can fail. You must postpone running REORG with SHRLEVEL CHANGE until all restart-pending statuses are removed. You can use the DISPLAY GROUP command to determine whether a member's status is failed. You can use the DISPLAY DATABASE command with the LOCKS option to determine if locks are held.

RECOVER-pending and REBUILD-pending status

You cannot reorganize a table space if any partition or range of partitions of the partitioned table space is in the RECOVER-pending status. Similarly, you cannot reorganize a single table space partition if any of the following conditions are true:

- The partition is in the RECOVER-pending status.
- The corresponding partitioning index is in the REBUILD-pending or RECOVER-pending status, and the data is unloaded by the cluster index method.
- The specified partition or partitions are a subset of a range of partitions that are in REORG-pending status; you must reorganize the entire range to reset the restrictive status.

The only RECOVER-pending restrictive state is:

RECP The table space, index space, or partition of a table space or index space is in a RECOVER-pending status. A single logical partition in RECP does not restrict access to other logical partitions that are not in RECP. You can reset RECP by recovering only the single logical partition.

The three REBUILD-pending restrictive states are:

RBDP REBUILD-pending status is set on a physical or logical index partition. The individual physical or logical partition is inaccessible and must be rebuilt by using the REBUILD INDEX utility.

PSRBD
Page set REBUILD-pending status is set for nonpartitioning indexes. The entire index space is inaccessible and must be rebuilt by using the REBUILD utility.

RBDP*
A REBUILD-pending status that is set only on logical partitions of nonpartitioning indexes. The entire index is inaccessible, but it is made available again when the affected partitions are rebuilt by using the REBUILD INDEX utility.

CHECK-pending status

If a table space is in both REORG-pending and CHECK-pending status (or auxiliary CHECK-pending status), run REORG first, and then run CHECK DATA to clear the respective states. Otherwise, if a table space is not in REORG-pending status, you cannot reorganize a table space or range of partitions if the table space or any partition in the range is in CHECK-pending status until the CHECK-pending status is removed.

REORG-pending status

You must allocate a discard data set (SYSDISC) or specify the DISCARDDN option if the last partition of the table space is in REORG-pending status.

Fallback recovery considerations

If RECOVER cannot use the latest image copy or copies as a starting point for the recovery, it attempts to use previous copies; if that attempt fails, RECOVER restores the data from the log.

However, if you use REORG SHRLEVEL NONE LOG NO, RECOVER cannot restore data from the log past the point at which the object was last reorganized successfully. Therefore, you must take an image copy after running REORG with LOG NO to establish a level of fallback recovery.

Recommendation:

Immediately following an ALTER INDEX operation that modifies key values, create a new recovery point by taking one of the following actions:

- Run REORG and specify COPYDDN and SHRLEVEL NONE.
- Take a full image copy immediately after REORG completes.

If you performed a REORG to reset REORG-pending status (REORP), you should also take an inline image copy or run the COPY utility. Image copies that are taken prior to resetting the REORG-pending status cannot be used for recovery to the current RBA or LRSN.

Successful REORG LOG NO processing inserts a row into SYSIBM.SYSCOPY with ICTYPE=W for each index that was defined with COPY YES. REORG also places a reorganized index in informational COPY-pending (ICOPY) status. You should take a full image copy of the index after the REORG job completes to create a valid point of recovery.

Restrictions when running REORG TABLESPACE on encrypted data

If you plan to run REORG TABLESPACE on encrypted data, do not use the WHEN statement to filter encrypted fields; REORG TABLESPACE cannot filter rows that contain encrypted data

Restriction for partitions with the COMPRESS YES attribute when using REBALANCE

Do not run REORG REBALANCE on a partitioned table space where a subset of partitions have the COMPRESS YES attribute and the remaining partitions have the COMPRESS NO attribute.

Restriction when using REBALANCE and duplicate partitioning key values exist

A REORG REBALANCE might distribute rows among the partitions that are being rebalanced in such a way that one or more partitions do not have any rows. This situation occurs when many rows with duplicate partitioning key values exist, and not enough unique values exist to enable REORG to distribute them over all of the partitions.

Restriction for unload parallelism when using REBALANCE

If you specify REORG REBALANCE, you cannot use unload parallelism.

Restrictions for XML table spaces with XML versioning

To REORG an XML table space, with XML versioning, that is in basic 6-byte page format, and that has tables with 8-byte time stamp columns, to extended 10-byte page format, you must REORG the entire table space. It cannot be done at the part level.

Restriction when physical partition numbers do not match logical partition numbers

A REORG REBALANCE might not be possible if the logical and physical partition numbers for the specified table space do not match. This situation can be created by a series of ALTER ROTATEs and ALTER ADD PARTs.

For example, assume that you create a table space with three partitions. The following table shows the mapping that exists between the physical and logical partition numbers.

Table 82. Mapping of physical and logical partition numbers when a table space with three partitions is created.

Logical partition number	Physical partition number
1	1
2	2
3	3

Then, assume that you request the following series of actions:

1. ALTER ROTATE FIRST TO LAST

   The new mapping of partition numbers is shown in the following table.

Table 83. Mapping of physical and logical partition numbers after ALTER ROTATE FIRST TO LAST.

Logical partition number	Physical partition number
1	2
2	3
3	1

2. ALTER ADD PART

   The new mapping of partition numbers is shown in the following table.

Table 84. Mapping of physical and logical partition numbers after ALTER ADD PART.

Logical partition number	Physical partition number
1	2
2	3
3	1
4	4

3. ALTER ROTATE FIRST TO LAST

   The new mapping of partition numbers is shown in the following table.

Table 85. Mapping of physical and logical partition numbers after second ALTER ROTATE FIRST TO LAST.

Logical partition number	Physical partition number
1	3
2	1
3	4
4	2

Assume that you then try to execute a REORG TABLESPACE REBALANCE PART 1:2. This statement requests a reorganization and rebalancing of physical partitions 1 and 2. Note that physical partition 1 is logical partition 2, and physical partition 2 is logical partition 4. Thus, the utility is processing logical partitions 2 and 4. If during the course of rebalancing, the utility needs to move keys from logical partition 2 to logical partition 3, the job fails, because logical partition 3 is not within the specified physical partition range.

Reorganizing a table space with an index that has a VARBINARY column

If you run REORG against a table space, and that table space includes a table that has an index with the following characteristics, REORG fails:
- The index was created on a VARBINARY column or a column with a distinct type that is based on a VARBINARY data type.
- The index column has the DESC attribute.

To fix the problem, drop the index, or alter the column data type to BINARY, and then rebuild the index

Related concepts:

Job DSNTEJ1 (DB2 Installation and Migration)

Related reference:

"CHECK-pending status" on page 1105

"REBUILD-pending status" on page 1109

"RECOVER-pending status" on page 1110

Data sets that REORG TABLESPACE uses

The REORG TABLESPACE utility uses a number of data sets during its operation.

The following table describes the data sets that REORG TABLESPACE uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set, and any optional data sets that you want to use.

Table 86. Data sets that REORG TABLESPACE uses

Data set	Description	Required?
RNPRIN*nn*	A data set that contains messages from the sort program (usually SYSOUT or DUMMY). This data set is used when distribution statistics are collected for column groups. *nn* is a number from 01 to the number of parallel subtasks.	No[1]
SYSIN	Input data set that contains the utility control statement.	Yes
SYSUT1	A temporary data set for sort input.	No
SYSPRINT	Output data set for messages.	Yes
STPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when statistics are collected on at least one data-partitioned secondary index, or when COLGROUP and FREQVAL keywords are specified.	Yes [1, 2, 14]
SYSDISC	Data set that contains discarded records from REORG DISCARD. The default DD name is SYSDISC.	No[4]

Table 86. Data sets that REORG TABLESPACE uses (continued)

Data set	Description	Required?
SYSPUNCH	Data set that contains a LOAD statement that is generated by REORG, which loads records that REORG DISCARD or REORG UNLOAD EXTERNAL wrote to the DISCARD or UNLOAD data sets. The default DD name is SYSPUNCH.	No[5]
UTPRINT	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY).	Yes
Unload data set	Data set that contains the unloaded data that is to be reloaded during the RELOAD phase. Specify its DD or template name with the UNLDDN option or with the RECDSN field on the DB2I Utilities panel. The data set must be a sequential data set that is readable by BSAM. The default DD name is SYSREC. The unload data set must be large enough to contain all the unloaded records from all the tables in the target table space.If at least one table in the table space does not have an index, REORG cannot use the SORTDATA method with SHRLEVEL CHANGE. As a result, you must unload the data in the SYSREC data set.	Yes[6]
Sequential copies	From one to four output data sets that are to contain the image copies. Specify their DD or template names with the COPYDDN and RECOVERYDDN options of the utility control statement.	No[7]
FlashCopy image copies	For table space or index space level copies, a VSAM data set for the output FlashCopy image copy of each partition or piece. For a partition level or piece level copy, a VSAM data set for the output FlashCopy image copy of the partition or piece.	No[13]
Work data sets	Temporary data sets for sort input and output. The DD names have the form DATAWK*nn*.	No[8]
Work data sets	Temporary data sets for sort input and output when sorting keys, or for sorting data when SORTDATA is specified but NOSYSREC is not. If index build parallelism is used, the DD names have the form SW*nn*WK*mm*. If index build parallelism is not used, the DD names have the form SORTWK*nn*	Yes[9]

Table 86. Data sets that REORG TABLESPACE uses (continued)

Data set	Description	Required?
Sort work data sets	Temporary data sets for sort input and output when collecting inline statistics on at least one data-partitioned secondary index, or when the COLGROUP option or the COLGROUP and FREQVAL options are specified. The DD names have the form ST01WK*nn*.	No[3,10,11]
Sort work data sets	Temporary data sets for unload parallelism. The DD names have the form DA*nn*WK*mm*.	Yes[11]
Sort work data sets	Temporary data sets for sort input and output when collecting distribution statistics for column groups. The DD names have the form RN*mm*WK*nn*, where *mm* is the subtask number, and *nn* is a sequence number for the data set allocated per task.	No[1,10,11]
Sort work data sets	Temporary data sets for sort input and output when collecting frequency statistics. The DD names have the form SORTWK01.	No[10,11]
Print data sets	Data sets for unload parallelism. The DD names have the form DTPRIN*nn*. Every time you invoke REORG TABLESPACE, new DTPRIN*nn* data sets are dynamically allocated. REORG TABLESPACE does not reuse DTPRIN*nn* data sets from previous job steps. This behavior might cause the available JES2 job queue elements to be consumed more quickly than expected.	Yes[11,12]

Note:

1. Required when collecting distribution statistics for column groups
2. STPRIN01 is required if statistics are being collected on at least one data-partitioned secondary index, but REORG TABLESPACE dynamically allocates the STPRIN01 data set if UTPRINT is allocated to SYSOUT.
3. Required when collecting inline statistics on at least one data-partitioned secondary index.
4. Required if you specify DISCARDDN
5. Required you specify PUNCHDDN
6. Required unless NOSYSREC or SHRLEVEL CHANGE is specified.
7. Required if a partition is in REORG-pending status or REBALANCE, COPYDDN, RECOVERYDDN, SHRLEVEL REFERENCE, or SHRLEVEL CHANGE is specified.
8. Required if NOSYSREC or SHRLEVEL CHANGE is specified, but SORTDEVT is not specified.
9. Required if any indexes exist and SORTDEVT is not specified.
10. If the DYNALLOC parm of the SORT program is not turned on, you need to allocate the data set. Otherwise, the sort program dynamically allocates the temporary data set.
11. If you specify the SORTDEVT keyword, the data sets are dynamically allocated. It is recommended that you use dynamic allocation by specifying SORTDEVT in the utility statement because dynamic allocation reduces the maintenance required of the utility job JCL.
12. If UTPRINT is allocated to SYSOUT, the data sets are dynamically allocated.
13. Required if you specify either FLASHCOPY YES or FLASHCOPY CONSISTENT.
14. Required when the COLGROUP and FREQVAL options are specified.

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space
Object that is to be reorganized.

Calculating the size of the unload data set

The required size for the unload data set varies depending on the options that you use for REORG.

1. If you use REORG with UNLOAD PAUSE or CONTINUE and you specify KEEPDICTIONARY (assuming that a compression dictionary already exists), the size of the unload data set, in bytes, is the VSAM high-allocated RBA for the table space. You can obtain the high-allocated RBA from the associated VSAM catalog.

   For SHRLEVEL CHANGE, also add the result of the following calculation (in bytes) to the VSAM high-used RBA:

   ```
   number of records * 11
   ```

2. If you use REORG with UNLOAD ONLY, UNLOAD PAUSE, or CONTINUE and you do not specify KEEPDICTIONARY, you can calculate the size of the unload data set, in bytes, by using the following formula:

   ```
   maximum row length * number of rows
   ```

   The maximum row length is the row length, including the 6-byte record prefix, plus the length of the longest clustering key. If multiple tables exist in the table space, use the following formula to determine the maximum row length:

   ```
   Sum over all tables ((row length + (2 * number of VARBIN
       columns)) * number of rows)
   ```

   For SHRLEVEL CHANGE, also add the result of the following formula to the preceding result:

   ```
   (21 * ((NEARINDREF + FARINDREF) * 1.1))
   ```

   In the preceding formula:

   NEARINDREF
   Is the value that is obtained from the NEARINDREF column of the SYSIBM.SYSTABLEPART catalog table. The accuracy of the data set size calculation depends on recent information in the SYSTABLEPART catalog table.

   FARINDREF
   Is the value that is obtained from the FARINDREF column of the SYSIBM.SYSTABLEPART catalog table.

3. If you have variable-length fields, the calculation in step 2 might result in excessive space. Use the average uncompressed row length, multiplied by the number of rows.
4. If you use REORG with UNLOAD PAUSE or CONTINUE with the DISCARD option, and the table has variable length fields, use the maximum row length in the calculation. The DISCARD option without the NOPAD option pads the variable length fields.

For certain table spaces in the catalog and directory, the unload data set for the table spaces have a different format. The calculation for the size of this data set is as follows:

```
data set size in bytes = (28 + longrow) * numrows
```

In the preceding formula:

longrow
Is the length of the longest row in the table space.

numrows
Is the number of rows in the data set.

The length of the row is calculated as follows:

```
Sum of column lengths + 4 bytes for each link
```

The length of the column is calculated as follows:

```
Maximum length of the column + 1 (if nullable) + 2 (if varying length)
```

Calculating the size of the sort work data sets

Allocating twice the space that is used by the unload data sets is usually adequate for the sort work data sets. For compressed data, double again the amount of space that is allocated for the sort work data sets if you use either of the following REORG options:

- UNLOAD PAUSE without KEEPDICTIONARY
- UNLOAD CONTINUE without KEEPDICTIONARY

Using two or three large SORTWK*nn* data sets is preferable to using several small ones. If adequate space is not available, you cannot run REORG.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. When you allocate sort work data sets on disk, the recommended amount of space to allow provides at least 1.2 times the amount of data that is to be sorted.

Specifying a destination for sort program messages

The REORG utility job step must contain a UTPRINT DD statement that defines a destination for messages that are issued by the sort program during the SORT phase of REORG. DB2I, the %DSNU CLIST command, and the DSNUPROC procedure use the following default DD statement:

```
//UTPRINT DD  SYSOUT=A
```

Calculating the size of the statistics sort work data sets:

To calculate the approximate size (in bytes) of the ST01WK*nn* data set, use the following formula:

2 ×(*maximum record length* × *numcols* × (*count* + 2) × number of indexes)

The variables in the preceding formula have the following values:

maximum record length
Maximum record length of the SYSCOLDISTSTATS record that is processed

when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

numcols
Number of key columns to concatenate when you collect frequent values from the specified index.

count Number of frequent values that DB2 is to collect.

Related concepts:

"Reorganizing the catalog and directory" on page 623

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Shadow data sets

When you execute the REORG utility with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, the utility uses shadow data sets.

For user-managed data sets, you must preallocate the shadow data sets before you execute REORG with SHRLEVEL REFERENCE or SHRLEVEL CHANGE. If a table space, partition, or index resides in DB2-managed data sets and shadow data sets do not already exist when you execute REORG, DB2 creates the shadow data sets. At the end of REORG processing, the DB2-managed shadow data sets are deleted.

Shadow data set names

Each shadow data set must have the following name:

catname.DSNDB*x*.*dbname*.*psname*.*y*000*z*.*Lnnn*

In the preceding name, the variables have the following meanings:

variable
meaning

catname
The VSAM catalog name or alias

x C or D

dbname
Database name

psname
Table space name or index name

y I or J

z 1 or 2

Lnnn Partition identifier. Use one of the following values:

- A001 through A999 for partitions 1 through 999
- B000 through B999 for partitions 1000 through 1999
- C000 through C999 for partitions 2000 through 2999
- D000 through D999 for partitions 3000 through 3999

- E000 through E996 for partitions 4000 through 4096

To determine the names of existing data sets, execute one of the following queries against the SYSTABLEPART or SYSINDEXPART catalog tables: GUPI

```
SELECT DBNAME, TSNAME, IPREFIX
  FROM SYSIBM.SYSTABLEPART
  WHERE DBNAME = 'dbname'
   AND TSNAME = 'psname';
SELECT DBNAME, IXNAME, IPREFIX
  FROM SYSIBM.SYSINDEXES X, SYSIBM.SYSINDEXPART Y
  WHERE X.NAME = Y.IXNAME
   AND X.CREATOR = Y.IXCREATOR
   AND X.DBNAME = 'dbname'
   AND X.INDEXSPACE = 'psname';
```

GUPI

For a partitioned table space, DB2 returns rows from which you select the row for the partitions that you want to reorganize.

For example, assume that you have a ten-partition table space and you want to determine a naming convention for the data set in order to successfully execute the REORG utility with the SHRLEVEL CHANGE PART 2:6 options. The following queries of the DB2 catalog tables SYSTABLEPART and SYSINDEXPART provide the required information:

GUPI

```
SELECT DBNAME, TSNAME, PARTITION, IPREFIX FROM SYSIBM.SYSTABLEPART
  WHERE DBNAME = 'DBDV0701' AND TSNAME = 'TPDV0701'
  ORDER BY PARTITION;
SELECT IXNAME, PARTITION, IPREFIX FROM SYSIBM.SYSINDEXPART
  WHERE IXNAME = 'IXDV0701
  ORDER BY PARTITION;
```

GUPI

The preceding queries produce the information that is shown in the following table.

The following table shows the results from the first query.

Table 87. Query results from the first preceding query

DBNAME	TSNAME	PARTITION	IPREFIX
DBDV0701	TPDV0701	1	I
DBDV0701	TPDV0701	4	I
DBDV0701	TPDV0701	3	J
DBDV0701	TPDV0701	2	I
DBDV0701	TPDV0701	5	J
DBDV0701	TPDV0701	6	J
DBDV0701	TPDV0701	7	I
DBDV0701	TPDV0701	8	I
DBDV0701	TPDV0701	9	I

Table 87. Query results from the first preceding query (continued)

DBNAME	TSNAME	PARTITION	IPREFIX
DBDV0701	TPDV0701	10	I

The following table shows the results from the second query.

Table 88. Query results from the second preceding query

IXNAME	PARTITION	IPREFIX
IXDV0701	10	I
IXDV0701	9	I
IXDV0701	8	I
IXDV0701	7	I
IXDV0701	6	J
IXDV0701	5	J
IXDV0701	4	I
IXDV0701	3	J
IXDV0701	2	I
IXDV0701	1	I

To execute REORG SHRLEVEL CHANGE PART 2:6, you need to preallocate the following shadow objects. The naming convention for these objects use information from the query results that are shown in the previous tables.

```
vcatnam.DSNDBC.DBDV0701.TPDV0701.J0001.A002
vcatnam.DSNDBC.DBDV0701.TPDV0701.I0001.A003
vcatnam.DSNDBC.DBDV0701.TPDV0701.J0001.A004
vcatnam.DSNDBC.DBDV0701.TPDV0701.I0001.A005
vcatnam.DSNDBC.DBDV0701.TPDV0701.I0001.A006
vcatnam.DSNDBC.DBDV0701.IXDV0701.J0001.A002
vcatnam.DSNDBC.DBDV0701.IXDV0701.I0001.A003
vcatnam.DSNDBC.DBDV0701.IXDV0701.J0001.A004
vcatnam.DSNDBC.DBDV0701.IXDV0701.I0001.A005
vcatnam.DSNDBC.DBDV0701.IXDV0701.I0001.A006
```

Defining shadow data sets

Consider the following actions when you preallocate the data sets:

- Allocate the shadow data sets according to the rules for user-managed data sets.
- Define the shadow data sets as LINEAR.
- Use SHAREOPTIONS(3,3).
- Define the shadow data sets as EA-enabled if the original table space or index space is EA-enabled.
- Allocate the shadow data sets on the volumes that are defined in the storage group for the original table space or index space.

If you specify a secondary space quantity, DB2 does not use it. Instead, DB2 uses the SECQTY value for the table space or index space.

Recommendation: Use the MODEL option, which causes the new shadow data set to be created like the original data set. This method is shown in the following example:

```
DEFINE CLUSTER +
   (NAME('catname.DSNDBC.dbname.psname.x0001.L001') +
   MODEL('catname.DSNDBC.dbname.psname.y0001.L001')) +
   DATA                                              +
   (NAME('catname.DSNDBD.dbname.psname.x0001.L001') +
   MODEL('catname.DSNDBD.dbname.psname.y0001.L001') )
```

Creating shadow data sets for indexes:

When you preallocate data sets for indexes, create the shadow data sets as follows:

- Create shadow data sets for the partition of the table space and the corresponding partition in each partitioning index and data-partitioned secondary index.
- Create a shadow data set for each nonpartitioned secondary index.

Use the same naming scheme for these index data sets as you use for other data sets that are associated with the base index, except use J0001 instead of I0001. For more information about this naming scheme, see the information about the shadow data set naming convention at the beginning of this topic.

Estimating the size of shadow data sets

If you have not changed the value of FREEPAGE or PCTFREE, the amount of required space for a shadow data set is comparable to the amount of required space for the original data set.

Preallocating shadow data sets for REORG PART

By creating the shadow data sets before executing REORG PART, even for DB2-managed data sets, you prevent possible over-allocation of the disk space during REORG processing. When reorganizing a partition, you must create the shadow data sets for the partition of the table space and for the partition of the partitioning index. In addition, before executing REORG PART with SHRLEVEL REFERENCE or SHRLEVEL CHANGE on partition *mmm* of a partitioned table space, you must create a shadow data set for each nonpartitioning index that resides in user-defined data sets. Each shadow data set is to be used for a copy of the index and must be as large as the entire original nonpartitioned index. The name for this shadow data set has the form *catname*.DSNDB*x*.*dbname*.*psname*.y0*mmm*.A*nnn*.

Concurrency and compatibility for REORG TABLESPACE

The REORG TABLESPACE utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions, and individual logical partitions of nonpartitioning indexes as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible. However, REORG SHRLEVEL CHANGE or REFERENCE on a partition or range of partitions rebuild entire nonpartitioned indexes; therefore, two REORG SHRLEVEL CHANGE or REFERENCE PART jobs on different partitions of the same table space are not compatible.

Restriction: You cannot run concurrent **REORG TABLESPACE SHRLEVEL CHANGE PART** *integer* on the same table space. Instead of submitting multiple jobs, you can merge the jobs into one job and specify a range using **REORG**

TABLESPACE SHRLEVEL CHANGE PART *integer1*:*integer2*, or specify **REORG TABLESPACE SHRLEVEL CHANGE SCOPE PENDING** if multiple partitions are in a REORG-pending state.

This information includes a series of tables that show which claim classes REORG drains and any restrictive state that the utility sets on the target object.

For nonpartitioned indexes, if you specify SHRLEVEL NONE, REORG PART:

- Drains only the logical partition (and the repeatable read class for the entire index)
- Does not set the page set REBUILD-pending status (PSRCP)
- Does not use PCTFREE or FREEPAGE attributes when inserting keys

Claim classes that REORG TABLESPACE drains

For SHRLEVEL NONE, the following table shows which claim classes REORG drains and any restrictive state that the utility sets on the target object. For each column, the table indicates the claim or drain that is acquired and the restrictive state that is set in the corresponding phase. UNLOAD CONTINUE and UNLOAD PAUSE, unlike UNLOAD ONLY, include the RELOAD phase and thus include the drains and restrictive states of that phase.

Table 89. Claim classes of REORG TABLESPACE SHRLEVEL NONE operations

Target	UNLOAD phase of REORG	RELOAD phase of REORG if UNLOAD CONTINUE or PAUSE	UNLOAD phase of REORG PART	RELOAD phase of REORG PART if UNLOAD CONTINUE or PAUSE
Table space, partition, or a range of partitions of a table space	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Partitioning index, data-partitioned secondary index, or partition of either type of index[1]	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Nonpartitioned index[2]	DW/UTRO	DA/UTUT	None	DR
Logical partition of nonpartitioning index[3]	None	None	DW/UTRO	DA/UTUT

Legend:

- DA: Drain all claim classes, no concurrent SQL access.
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTUT: Utility restrictive state, exclusive control.
- UTRO: Utility restrictive state, read-only access allowed.
- None: Any claim, drain, or restrictive state for this object does not change in this phase.

Note:

1. Includes document ID indexes and node ID indexes over partitioned XML table spaces.
2. Includes document ID indexes and node ID indexes over nonpartitioned XML table spaces and XML indexes.
3. Includes logical partitions of an XML index over partitioned XML table spaces.

For SHRLEVEL REFERENCE, the following table shows which claim classes REORG drains and any restrictive state that the utility sets on the target object. For each column, the table indicates the claim or drain that is acquired and the restrictive state that is set in the corresponding phase.

Table 90. Claim classes of REORG TABLESPACE SHRLEVEL REFERENCE operations

Target	UNLOAD phase of REORG	SWITCH phase of REORG	UNLOAD phase of REORG PART	SWITCH phase of REORG PART
Table space or partition of table space	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Partitioning index, data-partitioned secondary index, or partition of either[1]	DW/UTRO	DA/UTUT	DW/UTRO	DA/UTUT
Nonpartitioned secondary index[2]	DW/UTRO	DA/UTUT	CR/UTRW	DA/UTUT
Logical partition of nonpartitioning index[3]	None	None	DW/UTRO	DA/UTUT

Legend:

- CR: Claim read, concurrent access for SQL writers and readers
- DA: Drain all claim classes, no concurrent SQL access.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTUT: Utility restrictive state, exclusive control.
- UTRO: Utility restrictive state, read-only access allowed.
- UTRW: Utility restrictive state, read-write access allowed.
- None: Any claim, drain, or restrictive state for this object does not change in this phase.

Note:

1. Includes document ID indexes and node ID indexes over partitioned XML table spaces.
2. Includes document ID indexes and node ID indexes over nonpartitioned XML table spaces and XML indexes.
3. Includes logical partitions of an XML index over partitioned XML table spaces.

For REORG of an entire table space with SHRLEVEL CHANGE, the following table shows which claim classes REORG drains and any restrictive state that the utility sets on the target object.

Table 91. Claim classes of REORG TABLESPACE SHRLEVEL CHANGE operations

Target	UNLOAD phase	Last iteration of LOG phase	SWITCH phase
Table space	CR/UTRW[1]	DW/UTRO	DA/UTUT
Index	CR/UTRW[1]	DW/UTRO	DA/UTUT

Legend:

- CR: Claim the read claim class.
- DA: Drain all claim classes, no concurrent SQL access.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTUT: Utility restrictive state, exclusive control.
- UTRO: Utility restrictive state, read-only access allowed.
- UTRW: Utility restrictive state, read-write access allowed.

For REORG of a partition with SHRLEVEL CHANGE, the following table shows which claim classes REORG drains and any restrictive state that the utility sets on the target object.

Table 92. Claim classes of REORG TABLESPACE SHRLEVEL CHANGE operations on a partition

Target	UNLOAD phase	Last iteration of LOG phase	SWITCH phase
Partition of table space	CR/UTRW	DW/UTRO or DA/UTUT[1]	DA/UTUT
Partition of partitioned index	CR/UTRW	DW/UTRO or DA/UTUT[1]	DA/UTUT
Non-partitioned index	CR/UTRW	DW/UTRO or DA/UTUT[1]	DA/UTUT

Legend:
- CR: Claim the read claim class.
- DA: Drain all claim classes, no concurrent SQL access.
- DDR: Dedrain the read claim class, no concurrent access for SQL repeatable readers.
- DR: Drain the repeatable read class, no concurrent access for SQL repeatable readers.
- DW: Drain the write claim class, concurrent access for SQL readers.
- UTUT: Utility restrictive state, exclusive control.
- UTRO: Utility restrictive state, read-only access allowed.
- UTRW: Utility restrictive state, read-write access allowed.
- None: Any claim, drain, or restrictive state for this object does not change in this phase.

Note:

1. DA/UTUT applies if you specify DRAIN ALL.

Compatibility of REORG TABLESPACE with other utilities

The following table shows which utilities can run concurrently with REORG on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also shown.

Table 93. Compatibility of REORG TABLESPACE with other utilities

Action	REORG SHRLEVEL NONE UNLOAD CONTINUE or PAUSE, REORG SHRLEVEL REFERENCE, or REORG SHRLEVEL CHANGE	REORG SHRLEVEL NONE UNLOAD ONLY without clustering index	REORG SHRLEVEL NONE UNLOAD ONLY with clustering index
CATMAINT	No	No	No
CHECK DATA	No	No	No
CHECK INDEX	No	Yes	Yes
CHECK LOB	No	No	No
COPY INDEXSPACE	No	Yes	Yes
COPY TABLESPACE	No	Yes	Yes
DIAGNOSE	Yes	Yes	Yes
LOAD	No	No	No
MERGECOPY	No	No	No
MODIFY	No	No	No
QUIESCE	No	Yes	Yes
REBUILD INDEX	No	Yes	No
RECOVER INDEX	No	Yes	No
RECOVER INDEXSPACE	No	No	No

Table 93. Compatibility of REORG TABLESPACE with other utilities (continued)

Action	REORG SHRLEVEL NONE UNLOAD CONTINUE or PAUSE, REORG SHRLEVEL REFERENCE, or REORG SHRLEVEL CHANGE	REORG SHRLEVEL NONE UNLOAD ONLY without clustering index	REORG SHRLEVEL NONE UNLOAD ONLY with clustering index
RECOVER TABLESPACE	No	No	No
REORG INDEX	No	Yes	No
REORG TABLESPACE SHRLEVEL NONE UNLOAD CONTINUE or PAUSE, REORG SHRLEVEL REFERENCE, or REORG SHRLEVEL CHANGE	No	No	No
REORG TABLESPACE SHRLEVEL NONE UNLOAD ONLY or EXTERNAL	No	Yes	Yes
REPAIR DUMP or VERIFY	No	Yes	Yes
REPAIR LOCATE KEY or RID DELETE or REPLACE	No	No	No
REPAIR LOCATE INDEX PAGE REPLACE	No	Yes	No
REPAIR LOCATE TABLESPACE PAGE REPLACE	No	No	No
REPORT	Yes	Yes	Yes
RUNSTATS	No	Yes	Yes
STOSPACE	No	Yes	Yes
UNLOAD	No	Yes	Yes

The following table shows which DB2 operations can be affected when reorganizing catalog table spaces.

Table 94. DB2 operations that are affected by reorganizing catalog table spaces

Catalog table space	Actions that might not run concurrently
Any table space except SYSTSCPY, SYSTSCHX, SYSTSCKD, SYSTSSRG, and SYSTSCKS	CREATE, ALTER, and DROP statements
SYSTSCPY, SYSTSFAU, SYSTSCOL, SYSTSTSP, SYSTSTPT, SYSTSTAB, SYSTSIXS, SYSTSIXT, SYSTSIXR, SYSTSIPT, SYSTSREL, SYSTSFOR, SYSTSSYN, SYSTSFLD, SYSTSTAU, SYSTSDBA, SYSTSDBU, SYSTSKEY, SYSTSDBA, SYSTSDBU, SYSSTATS, SYSUSER, SYSHIST	Utilities

Table 94. DB2 operations that are affected by reorganizing catalog table spaces (continued)

Catalog table space	Actions that might not run concurrently
SYSTSFAU, SYSTSCOL, SYSTSTSP, SYSTSTPT, SYSTSTAB, SYSTSIXS, SYSTSIXT, SYSTSIXR, SYSTSIPT, SYSTSREL, SYSTSFOR, SYSTSSYN, SYSTSFLD, SYSTSTAU, SYSTSDBA, SYSTSDBU, SYSTSKEY, SYSTSDBA, SYSTSDBU, SYSGPAUT, SYSTSPKL, SYSTSPLY, SYSTSPKG, SYSTSPKS, SYSTSPKX, SYSTSPVR, SYSTSPKY, SYSTSPKD, SYSTSPKA, SYSTSPLN, SYSTSPLA, SYSTSDBR, SYSTSPLD, SYSTSSTM, SYSUSER	GRANT and REVOKE statements
SYSTSFAU, SYSTSCOL, SYSTSTSP, SYSTSTPT, SYSTSTAB, SYSTSIXS, SYSTSIXT, SYSTSIXR, SYSTSIPT, SYSTSREL, SYSTSFOR, SYSTSSYN, SYSTSFLD, SYSTSTAU, SYSTSDBA, SYSTSDBU, SYSTSKEY, SYSTSDBA, SYSTSDBU, SYSGPAUT, SYSTSPKL, SYSTSPLY, SYSTSPKG, SYSTSPKS, SYSTSPKX, SYSTSPVR, SYSTSPKY, SYSTSPKD, SYSTSPKA, SYSTSPLN, SYSTSPLA, SYSTSDBR, SYSTSPLD, SYSTSSTM, SYSSTATS, SYSUSER, SYSTSVEW, SYSTSVWT, SYSTSVTR, SYSTSVWD	BIND and FREE commands

Determining whether an object requires reorganization

You must reorganize an object if it is in the REORG-pending (REORP) restrictive status. Also, consider reorganizing an object if it is in an advisory REORG-pending status (AREO* or AREOR) or if analysis shows that reorganization might improve performance. Use the REORG INDEX or REORG TABLESPACE utility to reorganize the object.

About this task

Recommendation: Run the RUNSTATS utility if the statistics are not current. If the object should also be reorganized, run REORG with STATISTICS and take inline copies. If you run REORG PART and nonpartitioning indexes exist, subsequently run RUNSTATS for each nonpartitioning index.

Procedure

To determine whether an object requires reorganization, use any of the following approaches:

- Reorganize table spaces or partitions that are in REORG-pending status. Use the **DISPLAY DATABASE RESTRICT** command to display those table spaces and partitions that require reorganization.
- Run the REORG TABLESPACE utility and specify the OFFPOSLIMIT and INDREFLIMIT catalog query options with the REPORTONLY option. REORG produces a report with one of the following return codes, but the object is not reorganized.
  - **1** No limit met; no reorganization is performed or recommended.
  - **2** A reorganization is performed or recommended.

- Use the SYSTABLEPART and SYSINDEXPART catalog tables to find which table spaces and indexes qualify for reorganization. The information in these catalog tables can also be used to determine when the DB2 catalog table spaces require reorganization.

  Information from the SYSTABLEPART catalog table can also indicate how well disk space is being used. If you want to find the number of varying-length rows that were relocated to other pages because of an update, run RUNSTATS, and then issue the following statement: PSPI

```
SELECT CARD, NEARINDREF, FARINDREF
   FROM SYSIBM.SYSTABLEPART
   WHERE DBNAME = 'XXX'
   AND TSNAME = 'YYY';
```

  PSPI

  A large number (relative to previous values that you received) for FARINDREF indicates that I/O activity on the table space is high. If you find that this number increases over a time, you probably need to reorganize the table space to improve performance. You probably also need to increase PCTFREE or FREEPAGE for the table space with the ALTER TABLESPACE statement.

  The following statement returns the percentage of unused space in nonsegmented table space YYY. In nonsegmented table spaces, the space that is used by dropped tables is not reclaimed until you reorganize the table space.

  PSPI

```
SELECT PERCDROP
   FROM SYSIBM.SYSTABLEPART
   WHERE DBNAME = 'XXX'
   AND TSNAME = 'YYY';
```

  PSPI

  Issue the following statement to determine whether the rows of a table are stored in the same order as the entries of its clustering index: PSPI

```
SELECT NEAROFFPOSF, FAROFFPOSF
   FROM SYSIBM.SYSINDEXPART
   WHERE IXCREATOR = 'index_creator_name'
   AND IXNAME = 'index_name';
```

  PSPI

  Several indicators are available to signal a time for reorganizing table spaces. A large value for FAROFFPOSF might indicate that clustering is deteriorating. In this case, reorganize the table space to improve query performance.

  A large value for NEAROFFPOSF might indicate also that reorganization might improve performance. However, in general NEAROFFPOSF is not as critical a factor as FAROFFPOSF.

What to do next

For any table, the REORG utility repositions rows into the sequence of the key of the clustering index that is defined on that table.

For nonclustering indexes, the statistical information that is recorded by RUNSTATS in SYSINDEXES and SYSINDEXPART might be even worse after the clustering index is used to reorganize the data. This situation applies only to the

CLUSTERING and CLUSTERED columns in SYSINDEXES and to the NEAROFFPOS and FAROFFPOS columns in SYSINDEXPART.

Related tasks:

Maintaining data organization and statistics (DB2 Performance)

Related reference:

Chapter 33, "RUNSTATS," on page 737

SYSIBM.SYSTABLEPART table (DB2 SQL)

SYSIBM.SYSINDEXES table (DB2 SQL)

SYSIBM.SYSINDEXPART table (DB2 SQL)

"REORG-pending status" on page 1111

Access with REORG TABLESPACE SHRLEVEL

You can specify the level of access that you have to your data by using the SHRLEVEL option.

For reorganizing a table space, or a partition of a table space, the SHRLEVEL option lets you choose the level of access that you have to your data during reorganization.

- REORG with SHRLEVEL NONE, the default, reloads the reorganized data into the original area that is being reorganized. Applications have read-only access during unloading and no access during reloading. For data-partitioned secondary indexes, the option rebuilds the index parts during the BUILD phase. (Rebuilding these indexes does not create contention between parallel REORG PART jobs.) For nonpartitioned secondary indexes, the option corrects the indexes.
- REORG with SHRLEVEL REFERENCE reloads the reorganized data into a new (shadow) copy of the area that is being reorganized. Near the end of reorganization, DB2 switches the future access of the application from the original data to the shadow copy. For SHRLEVEL REFERENCE, applications have read-only access during unloading and reloading, and a brief period of no access during switching.
- REORG with SHRLEVEL CHANGE reloads the reorganized data into a shadow copy of the area that is being reorganized. For REORG TABLESPACE SHRLEVEL CHANGE, a mapping table correlates RIDs in the original copy of the table space or partition with RIDs in the shadow copy. Applications can read from and write to the original area, and DB2 records the writing in the log. DB2 then reads the log and applies it to the shadow copy to bring the shadow copy up to date. This step executes iteratively, with each iteration processing a sequence of log records. Near the end of reorganization, DB2 switches the future access of the application from the original data to the shadow copy. Applications have read-write access during unloading and reloading, a brief period of read-only access during the last iteration of log processing, and a brief period of no access during switching.
- REORG TABLESPACE SHRLEVEL CHANGE and COPY SHRLEVEL CHANGE are compatible and can run concurrently except during the period when exclusive control is needed to drain claimers of a target table space.

  Restriction:

  – COPY with the FLASHCOPY CONSISTENT option is not compatible with REORG.

- If REORG has drained the claimers of a table space or table space partition and a COPY utility is submitted to access the same object, the COPY utility terminates with a message that it is not compatible.
- If COPY and REORG are accessing the same table space or table space partitions, REORG cannot drain claimers until COPY completes. The REORG DRAIN options determine the actions taken.
- If COPY and REORG are accessing the same table space or table space partitions and COPY abends, restart of the COPY is not allowed if REORG completes.

- REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE materializes pending definition changes for table spaces and indexes if pending alterations are involved. Advisory-REORG pending status (AREOR) is reset for the table space and associated indexes. REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE at the partition level does not materialize pending definition changes at the table space level.

  REORG TABLESPACE with SHRLEVEL NONE proceeds without materializing pending definition changes if there were any on the object being reorganized.

  When pending definition changes are materialized during REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE, statistics for both table space and associated indexes are collected and updated in the DB2 catalog.
- REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE drops empty partitions from a partition-by-growth universal table space if the REORG_DROP_PBG_PARTS subsystem parameter is set to ENABLE. If this parameter is set to DISABLE, REORG TABLESPACE does not drop empty partitions.
- REORG TABLESPACE with the SHRLEVEL REFERENCE and REBALANCE options does not materialize pending definition changes for conversion of a partitioned table space to range-partitioned universal table space.
- REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE and the FASTSWITCH NO option does not materialize pending definition changes.
- When REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE is run with the AUX YES option on an entire base table space of one of the following types, the pending changes that are associated with the base table space are materialized, but the pending changes that are associated with the LOB table spaces are not materialized.
  - Simple table space
  - Segmented table space
  - Range-partitioned universal table space
  - Partition-by-growth universal table space
- When REORG TABLESPACE with SHRLEVEL REFERENCE or SHRLEVEL CHANGE is run with the AUX YES option on a subset of partitions of a partitioned table base table space, neither the pending changes that are associated with the base table space nor the pending changes that are associated with the LOB table spaces are materialized
- If large amounts of data are deleted from a partition-by-growth universal table space, including XML table spaces, run the REORG TABLESPACE utility with SHRLEVEL REFERENCE or SHRLEVEL CHANGE on the entire table space to reclaim physical space from the partition-by-growth table space.
- After RECOVER is run to recover a table space to a point in time before the materialization of pending definition changes, the entire table space or affected partitions are placed in REORG-pending (REORP) status. REORG TABLESPACE

with SHRLEVEL REFERENCE must be run on the entire table space or affected partitions to remove REORG-pending status and to complete the point-in-time recovery process.

Related information:

REORG DROP PBG PARTS field (REORG_DROP_PBG_PARTS subsystem parameter) (DB2 Installation and Migration)

Log processing with SHRLEVEL REFERENCE PART for nonpartitioned indexes or SHRLEVEL CHANGE:

When you specify SHRLEVEL REFERENCE PART for nonpartitioned indexes or SHRLEVEL CHANGE, DB2 processes the log to update the shadow copy. This step executes iteratively. The first iteration processes the log records that accumulated during the previous iteration. The iterations continue until one of these conditions is met:

- DB2 estimates that the time to perform the log processing in the next iteration will be less than or equal to the time that is specified for MAXRO. If this condition is met, the next iteration is the last iteration.
- DB2 estimates that the SWITCH phase will not start by the deadline that is specified for DEADLINE. If this condition is met, DB2 terminates reorganization.
- The number of log records that the next iteration is to process is not sufficiently lower than the number of log records that were processed in the previous iteration. If this condition is met but the first two conditions are not met, DB2 sends message DSNU377I to the console. DB2 continues log processing for the length of time that is specified for DELAY and then performs the action that is specified for LONGLOG.

Operator actions

LONGLOG specifies the action that DB2 performs if the pace of processing log records between iterations is slow. If no action is taken after message DSNU377I is sent to the console, the LONGLOG option automatically goes into effect. Some examples of possible actions that you can take:

- Execute the START DATABASE(*database*) SPACENAM(*tablespace*) ... ACCESS(RO) command and the QUIESCE utility to drain the write claim class. DB2 performs the last iteration, if MAXRO is not DEFER. After the QUIESCE, you should also execute the ALTER UTILITY command, even if you do not change any REORG parameters.
- Execute the START DATABASE(*database*) SPACENAM(*tablespace*) ... ACCESS(RO) command and the QUIESCE utility to drain the write claim class. Then, after reorganization makes some progress, execute the START DATABASE(*database*) SPACENAM(*tablespace*) ... ACCESS(RW) command. This increases the likelihood that processing of log records between iterations can continue at an acceptable rate. After the QUIESCE, you should also execute the ALTER UTILITY command, even if you do not change any REORG parameters.
- Execute the ALTER UTILITY command to change the value of MAXRO. Changing it to a huge positive value, such as 9999999, causes the next iteration to be the last iteration.
- Execute the ALTER UTILITY command to change the value of LONGLOG.
- Execute the TERM UTILITY command to terminate reorganization.
- Adjust the amount of buffer space that is allocated to reorganization and to applications. This adjustment can increase the likelihood that processing of log

records between iterations can continue at an acceptable rate. After adjusting the space, you should also execute the ALTER UTILITY command, even if you do not change any REORG parameters.

- Adjust the scheduling priorities of reorganization and applications. This adjustment can increase the likelihood that processing of log records between iterations can continue at an acceptable rate. After adjusting the priorities, you should also execute the ALTER UTILITY command, even if you do not change any REORG parameters.

DB2 does not take the action specified in the LONGLOG phrase if any one of these events occurs before the delay expires:

- An **ALTER UTILITY** command is issued.
- A **TERM UTILITY** command is issued.
- DB2 estimates that the time to perform the next iteration is likely to be less than or equal to the time specified on the MAXRO keyword.
- REORG terminates for any reason (including the deadline).

Related concepts:

"Before running REORG TABLESPACE" on page 599

Unloading without reloading

REORG can unload data without continuing and without creating a SYSIBM.SYSUTIL record after the job ends.

If you specify UNLOAD ONLY, REORG unloads data from the table space and then ends. You can reload the data at a later date with the LOAD utility, specifying FORMAT UNLOAD.

Between unloading and reloading, you can add a validation routine to a table. During reloading, all the rows are checked by the validation procedure.

Do not use REORG UNLOAD ONLY to propagate data. When you specify the UNLOAD ONLY option, REORG unloads only the data that physically resides in the base table space; LOB and XML columns are not unloaded. For purposes of data propagation, you should use UNLOAD or REORG UNLOAD EXTERNAL instead.

REORG UNLOAD ONLY and REORG UNLOAD EXTERNAL cannot be used to unload inline LOBs.

Reclaiming space from dropped tables

Reorganization omits tables that were previously dropped, reclaiming the space that they acquired. For partition-by-growth table spaces, you cannot use REORG to reclaim the space.

Related tasks:

"Reclaiming space in the DBD" on page 393

Reorganizing the catalog and directory

You can run REORG TABLESPACE on the table spaces in the catalog database (DSNDB06) and on the SCT02, SPT01, DBD01, SYSLGRNX, SYSDBDXA, SYSSPUXA, and SYSSPUXB table spaces in the directory database (DSNDB01).

Important:

You must take a full image copy before and after reorganizing any catalog or directory object. Otherwise, you cannot recover any catalog or directory objects without the full image copies. When you reorganize the DSNDB06.SYSTSCPY table space with the LOG NO option and omit the COPYDDN option, DB2 places the table space in COPY-pending status. Take a full image copy of the table space to remove the COPY-pending status before continuing to reorganize the catalog or directory table spaces.

Running REORG LOG NO COPYDDN avoids the COPY-pending status, because an inline copy is taken during the REORG.

The FASTSWITCH YES option is ignored for catalog and directory objects.

When to run REORG on the catalog and directory

You do not need to run REORG TABLESPACE on the catalog and directory table spaces as often as you do on user table spaces. RUNSTATS collects statistics about user table spaces, which you use to determine whether a REORG is necessary. You can use the same statistics to determine whether a REORG is needed for catalog and directory table spaces. However, DB2 does not generate statistics for certain items in the directory, such as the SYSLGRNX table space and its corresponding indexes DSNLLX01 and DSNLLX02.

Reorganize the whole catalog before a catalog migration or once every couple of years. Reorganizing the catalog is useful for reducing the size of the catalog table spaces. To improve query performance, reorganize the indexes on the catalog tables.

When statistical information indicates that you need to reorganize any of the catalog table spaces that are listed in the following table, you should also reorganize the corresponding directory table space. If the inline LOB length has changed, you should also reorganize any associated LOB directory table spaces.

Table 95. Catalog table spaces and their corresponding directory table spaces

Catalog table space	Corresponding directory table space	Associated LOB directory table spaces
DSNDB06.SYSTSFAU DSNDB06.SYSTSCOL DSNDB06.SYSTSFLD DSNDB06.SYSTSFOR DSNDB06.SYSTSIXS DSNDB06.SYSTSIPT DSNDB06.SYSTSKEY DSNDB06.SYSTSREL DSNDB06.SYSTSSYN DSNDB06.SYSTSTAU DSNDB06.SYSTSTPT DSNDB06.SYSTSTAB DSNDB06.SYSTSTSP	DSNDB01.DBD01	DSNDB01.SYSDBDXA
DSNDB06.SYSTSDBR DSNDB06.SYSTSPLN DSNDB06.SYSTSPLA DSNDB06.SYSTSPLD DSNDB06.SYSTSSTM	DSNDB01.SCT02	None
DSNDB06.SYSTSPKG DSNDB06.SYSTSPKA DSNDB06.SYSTSPKD DSNDB06.SYSTSPKL DSNDB06.SYSTSPKS DSNDB06.SYSTSPLY	DSNDB01.SPT01	DSNDB01.SYSSPUXA DSNDB01.SYSSPUXB

Associated directory table spaces

When certain catalog table spaces are reorganized, you should also reorganize the associated directory table space. The associated directory table spaces are listed in the previous table.

Limitations for reorganizing the catalog and directory

- You cannot reorganize DSNDB01.SYSUTILX.
- If SHRLEVEL NONE is specified, the UNLOAD ONLY or UNLOAD EXTERNAL and LOG YES options are not allowed for catalog and directory table spaces. However, LOG YES is required if SHRLEVEL NONE is specified for the catalog LOB table spaces. If SHRLEVEL REFERENCE is specified, LOG NO must be specified.
- The SORTDEVT and SORTNUM options are ignored for the following catalog and directory table spaces:
  - DSNDB06.SYSTSFAU
  - DSNDB06.SYSTSCOL
  - DSNDB06.SYSTSFLD
  - DSNDB06.SYSTSFOR
  - DSNDB06.SYSTSIXS
  - DSNDB06.SYSTSIPT
  - DSNDB06.SYSTSKEY
  - DSNDB06.SYSTSREL
  - DSNDB06.SYSTSSYN
  - DSNDB06.SYSTSTAU
  - DSNDB06.SYSTSTPT
  - DSNDB06.SYSTSTAB

- DSNDB06.SYSTSTSP
- DSNDB06.SYSTSDBA
- DSNDB06.SYSTSDBU
- DSNDB06.SYSTSSTG
- DSNDB06.SYSTSVOL
- DSNDB06.SYSTSDBR
- DSNDB06.SYSTSPLN
- DSNDB06.SYSTSPLA
- DSNDB06.SYSTSPLD
- DSNDB06.SYSTSSTM
- DSNDB06.SYSTSVWD
- DSNDB06.SYSTSVEW
- DSNDB01.DBD01
- Any LOB table spaces, such as DSNDB01.SYSDBDXA (For more information about restricted REORG options for LOB table spaces, see "Reorganization of a LOB table space" on page 639.)

The COPYDDN and RECOVERYDDN options are valid for the preceding catalog and directory tables if SHRLEVEL REFERENCE is also specified.

- REORG TABLESPACE with STATISTICS cannot collect inline statistics on the following catalog and directory table spaces:
  - DSNDB06.SYSTSFAU
  - DSNDB06.SYSTSCOL
  - DSNDB06.SYSTSFLD
  - DSNDB06.SYSTSFOR
  - DSNDB06.SYSTSIXS
  - DSNDB06.SYSTSIPT
  - DSNDB06.SYSTSKEY
  - DSNDB06.SYSTSREL
  - DSNDB06.SYSTSSYN
  - DSNDB06.SYSTSTAU
  - DSNDB06.SYSTSTPT
  - DSNDB06.SYSTSTAB
  - DSNDB06.SYSTSTSP
  - DSNDB06.SYSTSDBA
  - DSNDB06.SYSTSDBU
  - DSNDB06.SYSTSSTG
  - DSNDB06.SYSTSVOL
  - DSNDB06.SYSTSDBR
  - DSNDB06.SYSTSPLN
  - DSNDB06.SYSTSPLA
  - DSNDB06.SYSTSPLD
  - DSNDB06.SYSTSSTM
  - DSNDB06.SYSTSVWD
  - DSNDB06.SYSTSVEW
  - DSNDB06.SYSSTATS
  - DSNDB06.SYSHIST
  - DSNDB01.DBD01
  - Any LOB table spaces, such as DSNDB01.SYSDBDXA (For more information about restricted REORG options for LOB table spaces, see "Reorganization of a LOB table space" on page 639.)

Phases for reorganizing the catalog and directory

REORG TABLESPACE processes certain catalog and directory table spaces differently from other table spaces; it does not execute the BUILD and SORT phases for the following table spaces:

- DSNDB06.SYSTSFAU
- DSNDB06.SYSTSCOL
- DSNDB06.SYSTSFLD
- DSNDB06.SYSTSFOR
- DSNDB06.SYSTSIXS
- DSNDB06.SYSTSIPT
- DSNDB06.SYSTSKEY
- DSNDB06.SYSTSREL
- DSNDB06.SYSTSSYN
- DSNDB06.SYSTSTAU
- DSNDB06.SYSTSTPT
- DSNDB06.SYSTSTAB
- DSNDB06.SYSTSTSP
- DSNDB06.SYSTSDBA
- DSNDB06.SYSTSDBU
- DSNDB06.SYSTSSTG
- DSNDB06.SYSTSVOL
- DSNDB06.SYSTSDBR
- DSNDB06.SYSTSPLN
- DSNDB06.SYSTSPLA
- DSNDB06.SYSTSPLD
- DSNDB06.SYSTSSTM
- DSNDB06.SYSTSVWD
- DSNDB06.SYSTSVEW
- DSNDB01.DBD01

For these table spaces, REORG TABLESPACE reloads the indexes (in addition to the table space) during the RELOAD phase, rather than storing the index keys in a work data set for sorting.

For all other catalog and directory table spaces, DB2 uses index build parallelism.

Changing data set definitions

If the table space is defined by storage groups, DB2 allocates space, and you cannot alter data set definitions while a REORG job is in process. DB2 deletes and redefines the necessary data sets to reorganize the object.

About this task

For REORG with SHRLEVEL REFERENCE or CHANGE, you can use the ALTER STOGROUP command to change the characteristics of a DB2-managed data set. To change the characteristics of a user-managed data set, specify the new characteristics when you create the shadow data set. For example, placing the original and shadow data sets on different disk volumes might reduce contention and improve the performance of REORG and the performance of applications during REORG execution.

Related reference:

"Shadow data sets" on page 609

Temporarily interrupting REORG

You can temporarily pause REORG TABLESPACE.

If you specify UNLOAD PAUSE, REORG pauses after unloading the table space into the unload data set. You cannot use NOSYSREC and PAUSE. The job completes with return code 4. You can restart REORG by using the phase restart or current restart. Do not alter the REORG statement.

The REORG utility remains in stopped status until REORG is restarted or terminated.

While REORG is interrupted by PAUSE, you can redefine the table space attributes for user-defined table spaces. PAUSE is not required for STOGROUP-defined table spaces. Attribute changes are done automatically by a REORG following an ALTER TABLESPACE.

How to override dynamic sort work data set allocation

DB2 estimates how many records are to be sorted. This information is used for dynamic allocation of sort work space. Sort work space is allocated by DB2 or by the sort program that is used.

If the table space contains rows with VARCHAR columns, DB2 might not be able to accurately estimate the number of records. If the estimated number of records is too high, if the requested sort work space is not available, or if the estimated number of records is too low, which causes the sort to overflow, the utility might fail and cause an abend.

Recommendation: To enable DB2 to calculate a more accurate estimate:

- For a table space that is partitioned (non-universal), run RUNSTATS UPDATE ALL before REORG.
- For any other type of table space, run RUNSTATS UPDATE SPACE before REORG.

When you run RUNSTATS with SHRLEVEL REFERENCE, real-time statistics values are also updated.

You can override the dynamic allocation of sort work space in one of the following ways:

- Allocate the sort work data sets with SORTWK*nn* DD statements in your JCL.
- If the number of rows in the affected table space in column TOTALROWS of table SYSIBM.SYSTABLESPACESTATS is not available or is significantly incorrect, you can update the value to a more appropriate value using an SQL UPDATE statement. When REORG on the affected table space completes, TOTALROWS is set to the number of rows in the associated table space.
- If the number of keys for an associated index in column TOTALENTRIES of table SYSIBM.SYSINDEXSPACESTATS is not available or is significantly incorrect, you can update the value to a more appropriate value using an SQL UPDATE statement. The next time that REBUILD INDEX is run, TOTALENTRIES is set to the number of keys for the affected index.

Related reference:

DB2 Sort

Related information:

Redistributing data across partitions by using REORG

When data becomes skewed across partitions performance can be slower. You can correct the problem by redistributing the data more evenly across partitions. One way to redistribute the data is to let the REORG TABLESPACE utility determine any limit key changes and redistribute the data accordingly.

About this task

Alternatively, you can explicitly specify limit key values. If you want to specify your own limit key values, follow the instructions in Changing the boundary between partitions (DB2 Administration Guide).

Procedure

To redistribute data across partitions by using REORG:

Run the REORG TABLESPACE utility with the REBALANCE option. REBALANCE specifies that you want DB2 to determine the limit key changes for the partitioned table space and redistribute the data accordingly. The data remains available.

Restriction: REBALANCE is not allowed in any of the following situations:

- With the SCOPE PENDING option
- For partitioned-by-growth table spaces
- For table spaces with pending limit key changes

See the description of REBALANCE in the description of the REORG TABLESPACE syntax for a complete list of restrictions.
If the table has a clustering index that does not match the partitioning key, you must run REORG TABLESPACE twice. Running REORG twice ensures that the data is rebalanced and all rows are in clustering order. The first utility execution rebalances the data and the second utility execution sorts the data.
For example, assume that you have a table space that was created with the following SQL:

```
----------------------------------------
    SQL to create a table and index with
    separate columns for partitioning
    and clustering
----------------------------------------
  CREATE TABLESPACE TS IN DB
        USING STOGROUP SG
        NUMPARTS 4 BUFFERPOOL BP0;
  CREATE TABLE TB (C01 CHAR(5) NOT NULL,
                   C02 CHAR(5) NOT NULL,
                   C03 CHAR(5) NOT NULL)
        IN DB.TS
           PARTITION BY (C01)
              (PART 1 VALUES ('00001'),
               PART 2 VALUES ('00002'),
               PART 3 VALUES ('00003'),
               PART 4 VALUES ('00004'));
  CREATE INDEX IX ON TB(C02) CLUSTER;
```

To rebalance the data across the four partitions, use the following REORG TABLESPACE control statement:

```
REORG TABLESPACE DB.TS REBALANCE
```

After this utility job completes, the table space is placed in advisory REORG-pending (AREO*) status to indicate that a subsequent reorganization is recommended to ensure that the rows are in clustering order. For this subsequent reorganization, use the following REORG TABLESPACE control statement:

```
REORG TABLESPACE DB.TS
```

Related reference:

"Syntax and options of the REORG TABLESPACE control statement" on page 555

Appendix C, "Advisory or restrictive states," on page 1103

How partitions can be unloaded and reloaded in parallel

In some situations, the REORG utility attempts to unload and reload partitions in parallel. In other situations, parallel unloading and reloading does not occur.

REORG attempts to unload and reload table space partitions in parallel in the following situations:

- If you specify the NOSYSREC keyword.
- If the NOSYSREC keyword is defaulted like it is for SHRLEVEL CHANGE
- If you specify the UNLDDN keyword with a template name, where the template's data set name pattern includes a partition number.

REORG does not attempt to unload and reload table space partitions in parallel in the following situations:

- If the DATAWKnn DD statements are coded in the JCL.
- If you do not specify the SORTDEVT keyword.
- If the UTPRINT data set is not allocated to SYSOUT.
- If you specify the REBALANCE keyword.
- If rows might move from one partition to another as a result of alter limit keys or partition-by-growth table space.
- If you specify the UNLDDN keyword with a template name and specify UNIT(TAPE) STACK(YES).).
- When the number of subtasks that are started in parallel exceeds the value of the PARALLEL option or the PARAMDEG_UTIL subsystem parameter.

How to use inline copy with REORG TABLESPACE

You can create a full image copy data set (SHRLEVEL REFERENCE) during REORG TABLESPACE execution.

The new copy is an inline copy. The advantage to using an inline copy is that the table space is not left in COPY-pending status, regardless of which LOG option is specified for the utility. Thus, data availability is increased. You must take an inline copy when you specify the REBALANCE option.

To create an inline copy, use the COPYDDN and RECOVERYDDN keywords. You can specify up to two primary copies and two secondary copies. Inline copies are produced during the RELOAD phase of REORG processing.

The SYSCOPY record that is produced by an inline copy contains ICTYPE=F, SHRLEVEL=R. The STYPE column contains an X if the image copy was produced

by REORG TABLESPACE LOG(YES), and a W if the image copy was produced by REORG TABLESPACE LOG(NO). The data set that is produced by the inline copy is logically equivalent to a full image copy with SHRLEVEL REFERENCE, but the data within the data set differs in some respects:

- Data pages might be out of sequence and some might be repeated. If pages are repeated, the last one is always the correct copy.
- Space map pages are out of sequence and might be repeated

The total number of duplicate pages is small, with a negligible effect on the amount of space that is required for the data set. One exception to this guideline is the case of running REORG SHRLEVEL CHANGE, in which the number of duplicate pages varies with the number of records that are applied during the LOG phase.

Creating a FlashCopy image copy with REORG TABLESPACE

As part of REORG TABLESPACE processing, you can use FlashCopy technology to take image copies. This method is potentially faster than the traditional DB2 utility methods for creating inline copies and thus reduces the time that data is unavailable. FlashCopy image copies can also potentially reduce the time that is required for recovery operations.

About this task

REORG TABLESPACE can also create one to four additional inline image copies by using the traditional methods. Traditional inline image copies are output to a non-VSAM sequential format data set. For more information about traditional inline copies, see "How to use inline copy with REORG TABLESPACE" on page 629.

Restriction: You cannot create FlashCopy image copies if you specify UNLOAD ONLY or UNLOAD EXTERNAL in the REORG TABLESPACE utility control statement.

Procedure

To create a FlashCopy image copy with REORG TABLESPACE:

Specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT) in the REORG TABLESPACE utility control statement. Alternatively, you can set the FLASHCOPY_REORG_TS subsystem parameter to YES, which specifies that REORG TABLESPACE is to use FLASHCOPY(YES) by default. The value that you specify for the FLASHCOPY option in the REORG TABLESPACE statement always overrides the value for the FLASHCOPY_REORG_TS subsystem parameter. Optionally, you can also specify FCCOPYDDN in the REORG TABLESPACE statement. Use this option to specify a template for the FlashCopy image copy. If you do not specify the FCCOPYDDN option in the REORG TABLESPACE statement, the utility uses the value from the FCCOPYDDN subsystem parameter.

Restriction: The data sets that you specify for the FlashCopy image copy must be on FlashCopy Version 2 disk volumes.
When you specify FLASHCOPY(YES) or FLASHCOPY(CONSISTENT), REORG TABLESPACE uses FlashCopy technology to create a consistent copy of the target objects. If you also requested one or more traditional inline copies in the REORG TABLESPACE statement (by specifying COPYDDN or RECOVERYDDN), the utility

also creates those copies. REORG TABLESPACE does not use the FlashCopy image copy to create those traditional inline copies.
When you request a FlashCopy image copy, but you do not specify the COPYDDN option in the REORG TABLESPACE statement, and you do not include a SYSCOPY DD statement or a TEMPLATE statement with a SYSCOPY data set specification, REORG TABLESPACE does not create an inline image copy as well as a FlashCopy image copy. The table space is not placed in the COPY-pending state. However, when you request a FlashCopy image copy, and you do not specify the COPYDDN option in a REORG TABLESPACE statement, but you include a SYSCOPY DD statement or a TEMPLATE statement with a SYSCOPY data set specification, REORG TABLESPACE creates an inline image copy as well as a FlashCopy image copy.

Important: You should request a sequential image copy as well as a FlashCopy image copy when either of the following conditions are true:

- Your environment and system setup for FlashCopy image copies is not yet stable and predictable. If the FlashCopy process fails during the SWITCH phase, COPY-pending status is set if a sequential image copy is not taken.
- You want the FlashCopy image copy for fast local recovery, but require a sequential image copy to be shipped to a remote site for disaster recovery.

Related objects are copied if one of the following conditions is true:

- You specified REBALANCE in the REORG TABLESPACE statement.
- The partitioning key has changed since the last time the table space was reorganized
- The base table space is a partition-by-growth table space.

Failures occur in the following situations:

- The FlashCopy image copy fails if the FlashCopy Version 2 disk volumes are not available or if any of the other FlashCopy operational restrictions exist. For a list of those operational restrictions, see “FlashCopy image copies” on page 163.
- REORG TABLESPACE terminates if the FlashCopy image copy for the target table space fails, you specified SHRLEVEL REFERENCE or SHRLEVEL CHANGE, and inline copies were not taken. (If the FlashCopy image copy fails and you specified SHRLEVEL REFERENCE or SHRLEVEL CHANGE, but inline copies were taken, the utility continues.)

Related concepts:

“FlashCopy image copies” on page 163

Related reference:

DEFAULT TEMPLATE field (FCCOPYDDN subsystem parameter) (DB2 Installation and Migration)

REORG TABLESPACE field (FLASHCOPY_REORG_TS subsystem parameter) (DB2 Installation and Migration)

Improving REORG TABLESPACE performance

You can improve the performance of the REORG TABLESPACE utility by taking certain actions.

About this task

Recommendation: Run online REORG during light periods of activity on the table space or index.

Procedure

To improve REORG TABLESPACE performance:

- Run REORG concurrently on separate partitions of a partitioned table space if no nonpartitioned indexes exist. When you run REORG on partitions of a partitioned table space, the sum of each job's processor usage is greater than for a single REORG job on the entire table space. However, the elapsed time of reorganizing the entire table in parallel can be significantly less than it would be for a single REORG job.
- Use parallel index build for table spaces or partitions that have more than one defined index.
- Specify NOSYSREC on your REORG statement.
- If you are not using NOSYSREC, use an UNLDDN template to enable unload parallelism.
- If you are using 3990 caching, and you have the nonpartitioning indexes on RAMAC, consider specifying YES on the UTILITY CACHE OPTION field of installation panel DSNTIPE.

  This option allows DB2 to use sequential prestaging when reading data from RAMAC for the following utilities:
  – LOAD PART *integer* RESUME
  – REORG TABLESPACE PART

  For LOAD PART and REORG TABLESPACE PART utility jobs, prefetch reads remain in the cache longer, which can lead to possible improvements in the performance of subsequent writes.

  For REORG with SHRLEVEL CHANGE or SHRLEVEL REFERENCE, use inline statistics only if you can afford the additional cost of collecting statistics inline. Collecting statistics inline makes it unnecessary to run another RUNSTATS job after the REORG job. However, collecting statistics inline might substantially increase the length of time that the REORG job runs.
- Schedule REORG with SHRLEVEL CHANGE when the rate of writing is low and transactions are short. Avoid scheduling REORG with SHRLEVEL CHANGE when critical applications are executing.

  Under certain circumstances, the log records that REORG SHRLEVEL CHANGE uses contain additional information, as if DATA CAPTURE CHANGES were used. Generation of the additional information can slow applications and increase consumption of log space. The additional information is generated for all the tables in the table space if at least one table satisfies all these conditions:
  – The table has undergone ALTER TABLE ADD column.
  – The table does not use DATA CAPTURE CHANGES.
  – One of these conditions is true:
    - The area that is being reorganized uses data compression.
    - The area is a partitioned table space, and at least one partition uses data compression.
- Run REORG with DRAIN_WAIT.

  The DRAIN_WAIT option gives you greater control over the time that online REORG is to wait for drains. Also because the DRAIN_WAIT is the aggregate time that online REORG is to wait to perform a drain on a table space and associated indexes, the length of drains is more predictable than if each partition and index has its own individual waiting time limit.

  By specifying a short delay time (less than the system timeout value, IRLMRWT), you can reduce the impact on applications by reducing timeouts.

You can use the RETRY option to provide more opportunities for the online REORG to complete successfully. If you do not want to use RETRY processing, you can still use DRAIN_WAIT to set a specific and more consistent limit on the length of drains.

RETRY allows an online REORG that is unable to drain the objects that it requires so that DB2 can try again after a set period (RETRY_DELAY). During the RETRY_DELAY period, all the objects are available for read-write access in the case of SHRLEVEL CHANGE. For SHRLEVEL REFERENCE, the objects remain with the access that existed prior to the attempted drain (that is if the drain fails in the UNLOAD phase the object remains in read-write access; if the drain fails in the SWITCH phase, objects remain in read-only access).

Because application SQL statements can queue behind any unsuccessful drain that the online REORG has tried, define a reasonable delay before you try again to allow this work to complete; the default is 5 minutes.

When you specify DRAIN WRITERS (the default) with SHRLEVEL CHANGE and RETRY, multiple read-only log iterations can occur. Generally, online REORG might need to do more work when RETRY is specified, and this might result in multiple or extended periods of restricted access. Applications that run alongside online REORG need to perform frequent commits. During the interval between retries, the utility is still active, and consequently other utility activity against the table space and indexes is restricted.

- Run the REORG TABLESPACE utility with the PART SHRLEVEL REFERENCE or PART SHRLEVEL CHANGE option specified and the SORTNPSI YES or SORTNPSI AUTO option specified or subsystem parameter REORG_PART_SORT_NPSI enabled. When you run REORG TABLESPACE with these options, REORG TABLESPACE sorts all keys of the nonpartitioned secondary indexes and builds the shadow index from the sorted keys.

Parallel index building for REORG TABLESPACE

Parallel index building reduces the elapsed time for a REORG TABLESPACE job by sorting the index keys and rebuilding multiple indexes in parallel, rather than sequentially. Optimally, a pair of subtasks processes each index; one subtask sorts extracted keys, whereas the other subtask builds the index.

REORG TABLESPACE begins building each index as soon as the corresponding sort emits its first sorted record. The following figure shows the flow of a REORG TABLESPACE job that uses a parallel index build. DB2 starts multiple subtasks to sort index keys and build indexes in parallel. If you specify STATISTICS, additional subtasks collect the sorted keys and update the catalog table in parallel, eliminating the need for a second scan of the index by a separate RUNSTATS job.

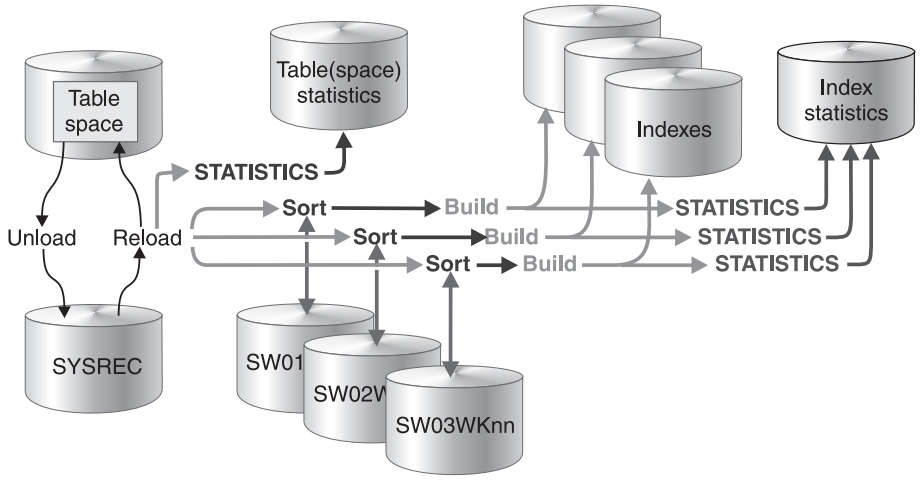


Figure 66. How indexes are built during a parallel index build

REORG TABLESPACE uses parallel index build if more than one index needs to be built (including the mapping index for SHRLEVEL CHANGE). You can either let the utility dynamically allocate the data sets that SORT needs for this parallel index build or provide the necessary data sets yourself. The number of subtasks must be less than or equal to the number that is specified by the PARALLEL option. If you do not specify the PARALLEL option, the PARAMDEG_UTIL subsystem parameter determines the maximum degree of parallelism for the utility.

Select one of the following methods to allocate sort work and message data sets:

Method 1:

REORG TABLESPACE determines the optimal number of sort work data sets and message data sets.

1. Specify the SORTDEVT keyword in the utility statement.
2. Allow dynamic allocation of sort work data sets by not supplying SORTWK*nn* DD statements in the REORG TABLESPACE utility JCL.
3. Allocate UTPRINT to SYSOUT.

Method 2:

Control allocation of sort work data sets, while REORG TABLESPACE allocates message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Allocate UTPRINT to SYSOUT.

Method 3:

Exercise the most control over rebuild processing; specify both sort work data sets and message data sets.

1. Provide DD statements with DD names in the form SW*nn*WK*mm*.
2. Provide DD statements with DD names in the form UTPRIN*nn*.

Data sets used

If you select Method 2 or 3 in the preceding information, define the necessary data sets by using the following information.

Each sort subtask must have its own group of sort work data sets and its own print message data set. Possible reasons to allocate data sets in the utility job JCL rather than using dynamic allocation are:

- To control the size and placement of the data sets
- To minimize device contention
- To optimally use free disk space
- To limit the number of utility subtasks that are used to build indexes

The DD name SW*nn*WK*mm* defines the sort work data sets that are used during utility processing. *nn* identifies the subtask pair, and *mm* identifies one or more data sets that are to be used by that subtask pair. For example:

SW01WK01
: Is the first sort work data set that is used by the subtask that builds the first index.

SW01WK02
: Is the second sort work data set that is used by the subtask that builds the first index.

SW02WK01
: Is the first sort work data set that is used by the subtask that builds the second index.

SW02WK02
: Is the second sort work data set that is used by the subtask that builds the second index.

The DD name UTPRIN*nn* defines the sort work message data sets that are used by the utility subtask pairs. *nn* identifies the subtask pair.

Every time you invoke REORG TABLESPACE, new UTPRIN*nn* data sets are dynamically allocated. REORG TABLESPACE does not reuse UTPRIN*nn* data sets from previous job steps. This behavior might cause the available JES2 job queue elements to be consumed more quickly than expected.

Number of sort subtasks

The maximum number of utility subtask pairs that are started for parallel index build is equal to the number of indexes that need to be built.

REORG TABLESPACE determines the number of subtask pairs according to the following guidelines:

- The number of subtask pairs equals the number of allocated sort work data set groups.
- The number of subtask pairs equals the number of allocated message data sets.
- If you allocate both sort work data sets and message data set groups, the number of subtask pairs equals the smallest number of allocated data sets.

Allocation of sort subtasks

REORG TABLESPACE attempts to assign one sort subtask pair for each index that is to be built. If REORG TABLESPACE cannot start enough subtasks to build one index per subtask pair, it allocates any excess indexes across the pairs; therefore one or more subtask pairs might build more than one index.

During parallel index build processing, REORG distributes all indexes among the subtask pairs according to the index creation date, assigning the first created index to the first subtask pair. For SHRLEVEL CHANGE, the mapping index is assigned last.

Estimating the sort work file size

If you choose to provide the data sets, you need to know the size and number of keys that are present in all of the indexes that are being processed by the subtask in order to calculate each sort work file size. After you determine which indexes are assigned to which subtask pairs, use the following formula to calculate the required space:

2 * (*longest index key + c*) * (*number of extracted keys*)

longest key
: The length of the longest index key that is to be processed by the subtask. If the index is of varying length, the longest key is the maximum possible length of a key with all varying-length columns that are padded to their maximum length, plus 2 bytes for each varying-length column in the index. For example, if an index with three columns (A, B, and C) has length values of CHAR(8) for A, VARCHAR(128) for B, and VARCHAR(50) for C, the longest key is calculated as follows:

  ```
  8 + 128 + 50 + 2 + 2 = 190
  ```

  For SHRLEVEL CHANGE, the mapping index key length is 21.

c
: A value as follows:
  - 10 if the indexes that are rebuilt are a mix of data-partitioned secondary indexes and nonpartitioned indexes
  - 8 if all indexes are partitioned or none of them are data-partitioned secondary indexes.

number of extracted keys
: The number of keys from all indexes that need to be sorted and that are to be processed by the subtask.

When you calculate the sort work data set size, do not count keys that are not sorted. Keys are not sorted when both of the following conditions are true:

- SORTDATA is in effect for REORG TABLESPACE, and the keys belong to a partitioning, clustering index.
- The table space is a partitioned table space, and data partitions are not being unloaded and reloaded in parallel.

The space estimation formula might indicate that 0 bytes are required, because the only index that is processed is the partitioning, clustering index. In this case, if you allocate your own groups of sort work data sets, you still need to allocate sort work data sets, but you can use a minimal allocation, such as 1 track.

Related tasks:

"Improving LOAD performance" on page 334

How DB2 unloads data

DB2 unloads data by table space scan with sort, table space scan, or clustering index.

DB2 unloads data by one of three methods:

- *Table space scan with sort:* If at least one table space has an index, DB2 uses a table space scan with a sort.
- *Table space scan:* DB2 uses a table space scan for simple table spaces that contain more than one table, or that contain one table but do not have an index.
- *Clustering index:* DB2 uses this option for simple table spaces that contain one table and have an index, and for tables in a segmented table space that have an index.

Failure during the RELOAD phase

Failure during the RELOAD phase (after the data is unloaded and data sets are deleted, but before the data is reloaded) results in an unusable table space.

If the error is on the table space data:

- If you have defined data sets, you can allocate new data sets.
- If STOGROUP has defined data sets, you can alter the new table space to change the primary and secondary quantities.
- If you allocate new data sets, alter the table space, or add volumes to the storage group, restart the REORG job at the beginning of the phase. Otherwise, you can restart either at the last commit point or at the beginning of the phase.

If the error is on the unloaded data, or if you used the NOSYSREC option, terminate REORG by using the **TERM UTILITY** command. Then recover the table space, using RECOVER, and run the REORG job again.

Reorganization of partitioned table spaces

If you reorganize a single partition or a range of partitions, all indexes of the table space are affected. Depending on how disorganized the nonpartitioning indexes are, you might want to reorganize them.

Related tasks:

"Determining which indexes require reorganization" on page 539

Reorganization of partition-by-growth table spaces

You can reorganize an entire partition-by-growth table space that does not contain LOB columns. In this case, the REORG TABLESPACE online utility condenses the data into the minimum number of required partitions.

Because the REORG TABLESPACE utility cannot reclaim physical space, the excess partitions are empty. If the data needs additional space, the REORG TABLESPACE utility triggers the process to add additional partitions if the maximum number of partitions has not been reached. If the maximum number of partitions has been reached, the REORG TABLESPACE utility fails.

If you specify REORG TABLESPACE PART for a partition-by-growth table space, the utility will fail if the data does not fit back into its partition because of the change in the free space parameter during the REORG. To prevent the utility from failing, run REORG TABLESPACE on the entire table space or modify the free space parameter to fit the data rows into the partition.

To ensure that the REORG utility is able to condense the data into the minimum number of required partitions, parallelism for the REORG utility does not apply to partition-by-growth table spaces.

If the partition-by-growth table space contains LOB columns, the REORG TABLESPACE utility minimizes partitions by eliminating existing holes, but does not move the data from one partition to another.

When you reorganize a partition-by-growth table space at the partition level, the REORG TABLESPACE utility minimizes partitions by eliminating existing holes.

If there is a compression dictionary, the compression dictionary is copied to all partitions even if the partition is empty.

By default, when you run REORG TABLESPACE against a partition-by-growth table space, DB2 adds new partitions as necessary, to accommodate the growth in size. In the following situations, the addition of new partitions might lead to failure of the utility because of a lack of disk space:

- When REORG TABLESPACE is run against a subset of the partitions in a partition-by-growth table space
- When REORG TABLESPACE AUX NO is run against a partition-by-growth table space in which a table contains LOB columns

For these situations only, you can alleviate space problems by taking one of the following actions:

- Execute ALTER TABLESPACE on the table space to change PCTFREE and FREEPAGE to 0. This action is the preferred solution.
- Instead of running REORG TABLESPACE against a subset of the partitions in a partition-by-growth table space, run REORG on the entire table space.
- Set the REORG_IGNORE_FREESPACE subsystem parameter to YES. Doing so causes the REORG utility not to honor the PCTFREE and FREEPAGE values that are defined for the table space. REORG uses 0 for the PCTFREE and FREEPAGE values when it reloads data into the table space.

Related reference:

ALTER TABLESPACE (DB2 SQL)

DB2 utilities parameters panel 2: DSNTIP61 (DB2 Installation and Migration)

Reorganization of segmented table spaces

The REORG TABLESPACE utility reorganizes segmented table spaces.

If the target table space is segmented, REORG unloads and reloads by table.

If an index exists on a table in a segmented table space, that table is unloaded in clustering sequence. If NO index exists, the table is unloaded in physical row and segment order.

For segmented table spaces, REORG does not normally need to reclaim space from dropped tables. Space that is freed by dropping tables in a segmented table space is immediately available if the table space can be accessed when DROP TABLE is executed. If the table space cannot be accessed when DROP TABLE is executed (for example, the disk device is offline), DB2 removes the table from the catalog, but does not delete all table rows. In this case, the space for the dropped table is not available until REORG reclaims it.

After you run REORG, the segments for each table are contiguous.

Comparison of the numbers of loaded and unloaded records

At the end of the RELOAD phase, REORG compares the number of records that were actually loaded to the number of records that were unloaded.

If the counts do not match, the resulting actions depend on the UNLOAD option that you specified on the original job:

- If you specify UNLOAD PAUSE, REORG sets return code 4 and continues processing the job.
- If you specify UNLOAD CONTINUE, DB2 issues an error message and abnormally terminates the job. The table space or partition remains in RECOVER-pending status.

Reorganization of a LOB table space

You can reorganize a LOB table space separately from the base table space. Alternatively, you can specify AUX YES when you reorganize the base table space and the associated LOB table spaces are also reorganized.

For information about reorganizing the base and LOB table spaces together, see AUX YES.

The rest of this topic refers to reorganizing a LOB table space separately from the base table space.

The REORG utility statement syntax for a LOB table space is almost the same as the syntax for running REORG on any other table space. The only difference is that some options are not applicable to LOB table spaces, including the following options:

- AUTOESTSPACE
- AUX YES
- DISCARD
- DISCARDDN
- INDREFLIMIT
- NOPAD
- NOSYSREC
- OFFPOSLIMIT
- PART
- PREFORMAT
- PUNCHDDN
- REBALANCE
- REPORTONLY

- REUSE
- ROWFORMAT
- SAMPLE
- SHRLEVEL NONE
- SORTDATA
- SORTDEVT
- STATISTICS
- UNLOAD ONLY
- UNLOAD EXTERNAL
- UNLOAD PAUSE
- KEEPDICTIONARY

For SHRLEVEL REFERENCE or CHANGE, LOBs are unloaded to a shadow data set and physical space is reclaimed. If you specify SHRLEVEL REFERENCE or CHANGE, you must also specify LOG NO and take an inline image copy. In this case, no updates are logged during the REORG.

Any attempt to run REORG SHRLEVEL NONE on a LOB table space results in a return code of 8 and a utility failure.

Reorganization of a LOB table space and base table space to complete recovery to a point in time before materialization of pending definition changes

A REORG job fails if all of the following conditions are true:

- AUX NO is in effect.
- REORG TABLESPACE is being issued to complete the process of recovery to a point in time prior to the materialization of pending definition changes.
- Pending definition changes exist on the base table space and on the associated LOB table space.
- REORG is run on the base table space before being run on the LOB table space.

To correct the problem and complete the recovery process, you need to run REORG on the LOB table space, and then run REORG again on the base table space.

If the pending definition changes are only on the LOB table space, you can run REORG only on the LOB table space to complete the point-in-time recovery process.

Reorganization of an XML table space

Reorganizing an XML table space is a separate task from reorganizing the base table space.

When you specify the name of the base table space in the REORG statement, DB2 reorganizes only that table space and not any related XML objects. If you want DB2 to reorganize the XML objects, you must specify those object names. When you specify that you want XML table spaces to be reorganized, you must also specify the WORKDDN keyword and provide the specified temporary work file. The default is SYSUT1.

When you run REORG on an XML table space that supports XML versions, REORG discards rows for versions of an XML document that are no longer needed.

For XML table spaces and base table spaces with XML columns, you cannot specify the following options in the REORG statement:

- DISCARD
- REBALANCE
- UNLOAD EXTERNAL

In the following example, the REORG statement specifies that DB2 is reorganizing table space BASETS01 and XML table spaces XML1TS01 and XML2TS01. During this reorganization DB2 is to take an inline copy of the base table space and gather statistics for all three table spaces.

```
//STEP1    EXEC DSNUPROC,UID='HUHRU252.REORG1',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN',DB2LEV=DB2A
//SYSREC   DD DSN=HUHRU252.REORG1.STEP1.SYSREC,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY1 DD DSN=HUHRU252.REORG1.STEP1.SYSCOPY1,
//         DISP=(MOD,CATLG,CATLG),UNIT=SYSDA,
//         SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD DSN=IUJLU101.REORG.STEP1.SYSUT1,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT2   DD DSN=IUJLU101.REORG.STEP1.SYSUT2,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)

//SYSIN    DD *
REORG TABLESPACE DBHR5201.BASETS01
      SHRLEVEL CHANGE MAPPINGTABLE MAP1
      COPYDDN(SYSCOPY1)
      STATISTICS TABLE(ALL)
                 INDEX(ALL)
REORG TABLESPACE DBHR5201.XML1TS01
      SHRLEVEL CHANGE MAPPINGTABLE MAP2
      STATISTICS TABLE(ALL)
                 INDEX(ALL)
                 WORKDDN(SYSUT1)
REORG TABLESPACE DBHR5201.XML2TS01
      SHRLEVEL CHANGE MAPPINGTABLE MAP3
      STATISTICS TABLE(ALL)
                 INDEX(ALL)
                 WORKDDN(SYSUT2)

/*
```

Reorganization with pending definition changes

A REORG utility operation that materializes pending definition changes is equivalent to a data definition change that happens during an online transaction. REORG requires the same type of serialization that any data definition change requires in addition to the existing draining serialization it performs on the target object.

Therefore, to avoid possible application outages, try to run REORG at a time when the data is not heavily accessed, which allows for the data definition change to be materialized.

A REORG operation that materializes definition changes enables you to alter certain objects without significantly impacting availability. The data is unavailable for only a short time. This short time of unavailability happens during any REORG SHRLEVEL CHANGE operation."

However, a REORG operation that materializes pending definition changes does have a cost. REORG begins serialization with the concurrent application during the last log iteration in the LOG phase and changes schema definitions during the SWITCH phase. During this time, plans, packages, and the dynamic statement cache are quiesced and invalidated, and statistics and dynamic SQL are blocked. As a result, the DRAIN ALL behavior that REORG performs when it does not materialize pending definition changes is not sufficient. For example, assume that an agent sees a segmented table space and claims and waits for REORG to release the drain. At the same time, REORG materializes the pending definition change and changes the table space from segmented to partition-by-growth. If REORG does not block the agent before its claim, after REORG releases the drain, the agent continues to access the table space with the attributes that it had before REORG ran. This situation can result in unpredictable behaviors. Application lock timeout errors are possible, because REORG was unable to acquire the locks on either the SYSIBM.SYSTABLESPACE record or on the plans or packages. The IRLM lock timeout value applies for these locks. REORG can hold these locks for longer than the IRLMRWT threshold because it must acquire multiple locks. (When REORG is not materializing definition changes, it needs only a single drain lock.) The value of the DRAIN_WAIT utility option does not apply to these lock timeouts.

Related concepts:

"Access with REORG TABLESPACE SHRLEVEL" on page 619

Related tasks:

Materializing pending definition changes (DB2 Administration Guide)

Related reference:

RESOURCE TIMEOUT field (IRLMRWT subsystem parameter) (DB2 Installation and Migration)

Compression after materialization of inline LOB changes

The REORG TABLESPACE utility can be run on a base table space to materialize the conversion of an auxiliary LOB table space to an inline LOB. However, if the object is defined with compression, the result of the reorganization can be little or no row compression in some of the partitions.

Introductory concepts:

The effect of data compression on performance (Introduction to DB2 for z/OS)

To achieve better compression, run REORG TABLESPACE a second time on the table space that contains the inline LOB to build a new compression dictionary and attempt better compression.

Termination of REORG TABLESPACE

You can terminate the REORG TABLESPACE utility.

If you terminate REORG TABLESPACE with the **TERM UTILITY** command during the UNLOAD phase, objects have not yet been changed, and you can rerun the job.

If you terminate REORG TABLESPACE with the **TERM UTILITY** command during the RELOAD phase, the behavior depends on the SHRLEVEL option:

- For SHRLEVEL NONE, the data records are not erased. The table space and indexes remain in RECOVER-pending status. After you recover the table space, rerun the REORG job.
- For SHRLEVEL REFERENCE or CHANGE, the data records are reloaded into shadow objects, so the original objects have not been affected by REORG. You can rerun the job.

If you terminate REORG with the **TERM UTILITY** command during the SORT, BUILD, or LOG phases, the behavior depends on the SHRLEVEL option:

- For SHRLEVEL NONE, the indexes that are not yet built remain in RECOVER-pending status. You can run REORG with the SORTDATA option, or you can run REBUILD INDEX to rebuild those indexes.
- For SHRLEVEL REFERENCE or CHANGE, the records are reloaded into shadow objects, so the original objects have not been affected by REORG. You can rerun the job.

If you terminate a stopped REORG utility with the **TERM UTILITY** command during the SWITCH phase, the following conditions apply:

- All data sets that were renamed to their shadow counterparts are renamed to their original names, so that the objects remain in their original state, and you can rerun the job.
- If a problem occurs in renaming the data sets to the original names, the objects remain in RECOVER-pending status, and you cannot rerun the job.

If the SWITCH phase does not complete, the image copy that REORG created is not available for use by the RECOVER utility. If you terminate an active REORG utility during the SWITCH phase with the **TERM UTILITY** command, during the rename process, the renaming occurs, and the SWITCH phase completes. The image copy that REORG created is available for use by the RECOVER utility.

The REORG-pending status is not reset until the UTILTERM execution phase. If the REORG utility abnormally terminates or is terminated, the objects remain in REORG-pending status and RECOVER-pending status, depending on the phase in which the failure occurred.

The following table lists the restrictive states that REORG TABLESPACE sets according to the phase in which the utility terminated.

Table 96. Restrictive states that REORG TABLESPACE sets.

Phase	Effect on restrictive status
UNLOAD	No effect.
RELOAD	SHRLEVEL NONE: • Places table space in RECOVER-pending status at the beginning of the phase and resets the status at the end of the phase. • Places indexes in RECOVER-pending status. • Places the table space in COPY-pending status. If COPYDDN is specified and SORTKEYS is ignored, the COPY-pending status is reset at the end of the phase. SORTKEYS is ignored for several catalog and directory table spaces SHRLEVEL REFERENCE or CHANGE has no effect.

Table 96. Restrictive states that REORG TABLESPACE sets. (continued)

Phase	Effect on restrictive status
SORT	No effect.
BUILD	SHRLEVEL NONE resets RECOVER-pending status for indexes and, if the utility job includes both COPYDDN and SORTKEYS, resets COPY-pending status for table spaces at the end of the phase. SHRLEVEL REFERENCE or CHANGE has no effect.
SORTBLD	No effect during the sort portion of the SORTBLD phase. During the build portion of the SORTBLD phase, the effect is the same as for the BUILD phase.
LOG	No effect.
SWITCH	No effect. Under certain conditions, if TERM UTILITY is issued, it must complete successfully; otherwise, objects might be placed in RECOVER-pending status.

Recovering a failed REORG job

If you terminate REORG SHRLEVEL NONE in the RELOAD phase, all SYSLGRNX records associated with the reorganization are deleted. Use the RECOVER TABLESPACE utility to recover to the current point in time. This action recovers the table space to its state before the failed reorganization.

Related concepts:

"Reorganizing the catalog and directory" on page 623

Related tasks:

"Terminating an online utility" on page 51

Related reference:

Appendix C, "Advisory or restrictive states," on page 1103

Restart of REORG TABLESPACE

You can restart a REORG TABLESPACE utility job.

By default, DB2 uses RESTART(CURRENT) when restarting REORG TABLESPACE jobs, with the following exceptions:

- Jobs that are restarted in the SORT, BUILD, or SWITCH phase use RESTART(PHASE) by default.
- Jobs with the SORTKEYS option that are restarted in the RELOAD, SORT, BUILD, or SORTBLD phase always restart from the beginning of the RELOAD phase.
- Jobs with the SHRLEVEL REFERENCE, NOSYSREC, and SORTDATA options use RESTART(PHASE) to restart at the beginning of the UNLOAD phase.
- Jobs with unload parallelism for REORG TABLESPACE SHRLEVEL NONE use RESTART(PHASE) to restart at the beginning of the UNLOAD and RELOAD phases.
- Jobs that reorganize LOB table spaces use RESTART(PHASE).

If you restart a REORG job of one or more of the catalog or directory table spaces in the preceding list, you cannot use RESTART(CURRENT).

If you restart REORG in the UTILINIT phase, it re-executes from the beginning of the phase. If REORG abnormally terminates or system failure occurs while it is in the UTILTERM phase, you must restart the job with RESTART(PHASE).

The following table provides information about restarting REORG TABLESPACE, depending on the phase that REORG was in when the job stopped. For each phase of REORG and for each type of REORG TABLESPACE (with SHRLEVEL NONE, with SHRLEVEL REFERENCE, and with SHRLEVEL CHANGE), the following table indicates the types of restarts that are allowed (CURRENT and PHASE). A value of None indicates that no restart is allowed. The "Data Sets Required" column lists the data sets that must exist to perform the specified type of restart in the specified phase.

Table 97. REORG TABLESPACE utility restart information for SHRLEVEL NONE, REFERENCE, and CHANGE

Phase	Type of restart allowed for SHRLEVEL NONE	Type of restart allowed for SHRLEVEL REFERENCE	Type of restart allowed for SHRLEVEL CHANGE	Required data sets	Notes
UNLOAD	CURRENT, PHASE	CURRENT, PHASE[6]	None	SYSREC	
RELOAD	CURRENT, PHASE	CURRENT, PHASE[6]	None	SYSREC	1, 2
SORT	CURRENT, PHASE	CURRENT, PHASE[6]	None	None	2, 3
BUILD	CURRENT, PHASE	CURRENT, PHASE[6]	None	None	2, 3, 4
SORTBLD	CURRENT, PHASE	CURRENT, PHASE[6]	None	None	2
LOG	Phase does not occur	Phase does not occur[6]	None	None	
SWITCH	Phase does not occur	CURRENT, PHASE	CURRENT, PHASE	Originals and shadows	3, 5

Note:

1. For None, if you specify NOSYSREC, restart is not possible, and you must execute the RECOVER TABLESPACE utility for the table space or partition. For REFERENCE, if the REORG job includes both SORTDATA and NOSYSREC, RESTART or RESTART(PHASE) restarts at the beginning of the UNLOAD phase.
2. If you specify SHRLEVEL NONE or SHRLEVEL REFERENCE, and the job includes the SORTKEYS option, use RESTART or RESTART(PHASE) to restart at the beginning of the RELOAD phase.
3. You can restart the utility with RESTART or RESTART(PHASE). However, because this phase does not take checkpoints, RESTART restarts from the beginning of the phase.
4. If you specify the PART option with REORG TABLESPACE, you cannot restart the utility at the beginning of the BUILD phase if any nonpartitioning index is in a page set REBUILD-pending (PSRBD) status.
5. If you specify REORG TABLESPACE SHRLEVEL REFERENCE PART with one or more nonpartitioned indexes, restart is allowed only in the SWITCH phase.
6. For REORG TABLESPACE with SHRLEVEL REFERENCE and PART, if a nonpartitioned index is defined on the table space, REORG TABLESPACE cannot be restarted before the SWITCH phase.

If you restart a REORG STATISTICS job by using RESTART CURRENT, inline statistics are not collected. To update catalog statistics, run the RUNSTATS utility after the restarted job completes. Restarting a REORG STATISTICS job with RESTART(PHASE) is conditional after executing UNLOAD PAUSE. To determine if catalog table statistics are going to be updated, see the following table. This table

shows whether or not statistics are updated for REORG STATISTICS jobs according to the phase in which the job terminated and the restart value that was used.

Table 98. Statistics collection for REORG TABLESPACE utility phase restart

Phase	CURRENT	PHASE
UTILINIT	NO	YES
UNLOAD	NO	YES
RELOAD	NO	YES
SORT	NO	NO
BUILD	NO	YES
SORTBLD	NO	YES

Related tasks:

"Restarting an online utility" on page 52

"Restarting a utility after the output data set is full" on page 57

Review of REORG TABLESPACE output

The output from the REORG TABLESPACE utility consists of a reorganized table space, partition, or a range of partitions.

The following table summarizes the effect of REORG on a table space partition and on the corresponding index partition.

Table 99. Summary of the results of REORG TABLESPACE according to the type of specification.

Specification	Results
REORG TABLESPACE	All data + entire partitioning index + all nonpartitioning indexes
REORG TABLESPACE PART *n*	Data for PART *n* + PART *n* of the partitioning index + index entries for PART *n* in all nonpartitioning indexes
REORG TABLESPACE PART *n1*:*n2*	Data for PART *n1* through *n2* + PART *n1* through *n2* of the partitioning index + index entries for those partitions in all nonpartitioning indexes
REORG TABLESPACE SCOPE PENDING	Specified table space or partitions that are in REORG-pending status.
REORG SHRLEVEL CHANGE PART and SHRLEVEL REFERENCE PART	Unloads and builds entire NPIs, so that the NPI is largely reorganized even though only a part of the data is actually reorganized.

When reorganizing a segmented table space, REORG leaves free pages and free space on each page in accordance with the current values of the FREEPAGE and PCTFREE parameters. (You can set those values by using the CREATE TABLESPACE, ALTER TABLESPACE, CREATE INDEX, or ALTER INDEX statements). REORG leaves one free page after reaching the FREEPAGE limit for each table in the table space. When reorganizing a nonsegmented table space, REORG leaves one free page after reaching the FREEPAGE limit, regardless of whether the loaded records belong to the same or different tables.

After running REORG TABLESPACE

Certain activities might be required after you run the REORG TABLESPACE utility, depending on your situation.

After a reorganization is complete, perform the following actions:

- If you have used LOG YES, consider taking an image copy of the reorganized table space or partition to:
  - Provide a full image copy for recovery. This action prevents the need to process the log records that are written during reorganization.
  - Permit making incremental image copies later.

  You might not need to take an image copy of a table space for which all the following statements are true:
  - The table space is relatively small.
  - The table space is used only in read-only applications.
  - The table space can be easily loaded again in the event of failure.

  In addition, you do not need to take an image copy if you used COPYDDN or FCCOPYDDN to take an inline image copy when you ran REORG.
- Use the RUNSTATS utility on the table space and its indexes if inline statistics were not collected, so that the DB2 catalog statistics take into account the newly reorganized data, and SQL paths can be selected with accurate information. You need to run RUNSTATS on nonpartitioning indexes only if you reorganized a subset of the partitions.
- If you use REORG TABLESPACE SHRLEVEL CHANGE with a mapping table, you can drop the mapping table and its index.
- If you use SHRLEVEL REFERENCE or CHANGE, and a table space, partition, or index resides in user-managed data sets, you can delete the user-managed shadow data sets.
- If you specify DISCARD on a REORG of a table that is involved in a referential integrity set, you need to run CHECK DATA for any affected referentially related objects that were placed in CHECK-pending status.

Related reference:

Chapter 15, “COPY,” on page 139

Effects of running REORG TABLESPACE

Running the REORG TABLESPACE utility can have effects on index version numbers and the version of the data, control intervals, row formats, and table spaces that are defined with the NOT LOGGED attribute.

The effect of REORG TABLESPACE on index version numbers and the version of the data

DB2 stores the range of used version numbers in the OLDEST_VERSION and CURRENT_VERSION columns of one or more of the following catalog tables, depending on the object:

- SYSIBM.SYSTABLESPACE
- SYSIBM.SYSTABLESPART
- SYSIBM.SYSINDEXES
- SYSIBM.SYSINDEXPART

The OLDEST_VERSION column contains the oldest used version number, and the CURRENT_VERSION column contains the current version number.

When you run REORG TABLESPACE, the utility sets all of the rows in the table or partition to the current object version. The utility also updates the range of used version numbers for indexes that are defined with the COPY NO attribute. REORG TABLESPACE sets the OLDEST_VERSION column equal to the CURRENT_VERSION column in the appropriate catalog column. These updated values indicate that only one version is active. DB2 can then reuse all of the other version numbers.

Recycling of version numbers is required when all of the version numbers are being used. All version numbers are being used when one of the following situations is true:

- The value in the CURRENT_VERSION column is one less than the value in the OLDEST_VERSION column.
- The value in the CURRENT_VERSION column is 255 for table spaces or 15 for indexes, and the value in the OLDEST_VERSION column is 0 or 1.

You can also run LOAD REPLACE, REBUILD INDEX, or REORG INDEX to recycle version numbers for indexes that are defined with the COPY NO attribute. To recycle version numbers for indexes that are defined with the COPY YES attribute or for table spaces, run MODIFY RECOVERY.

The effect of REORG TABLESPACE on the control interval

When you run REORG TABLESPACE without the REUSE option and the target data set is managed by DB2, DB2 deletes this data set before REORG processing begins. DB2 then redefines a new data set with a control interval that matches the page size.

The effect of REORG TABLESPACE on row format

When you run REORG with the ROWFORMAT RRF option on a table space or partition that is in basic row format, REORG converts that table space or partition to reordered row format. If the ROWFORMAT BRF option is specified, existing basic row format table spaces are not converted to reordered row format. If there is a table in the table space with an EDITPROC or VALIDPROC, the table space or partition remains in basic row format after the REORG.

If you run REORG on a catalog or directory table space, the catalog or directory table space remains in basic row format.

You can run REORG TABLESPACE on table spaces that contain some partitions in basic row format and some partitions in reordered row format. In this case, the utility converts the partitions that are in basic row format to reordered row format.

REORG TABLESPACE converts a undefined table space to reordered row format if both of the following conditions are true:

- ROWFORMAT RRF is explicitly specified.
- The specified target is an entire undefined table space in basic row format.

In this case, DB2 updates the row format definition in the catalog and directory. No data sets are defined for the table space.

The effect of REORG on table spaces that are defined with NOT LOGGED attribute

The following table shows the effect of REORG on table spaces that are defined with the NOT LOGGED attribute.

Table 100. REORG parameters

LOAD REORG LOG keyword	Table space logging attribute	Table space type	What is logged	Table space status after utility completes
LOG YES	NOT LOGGED	Non-LOB	LOG YES changes to LOG NO	No pending status or ICOPY-pending[1]
LOG YES	NOT LOGGED	LOB	control information	No pending status
LOG NO	NOT LOGGED	Non-LOB	nothing	No pending status or ICOPY-pending[1]
LOG NO	NOT LOGGED	LOB	nothing	No pending status

Note:

1. The table space is set to ICOPY-pending status if the records are discarded and no pending status is the records are not discarded.

Sample REORG TABLESPACE control statements

Use the sample control statements as models for developing your own REORG TABLESPACE control statements.

Example 1: Reorganizing a table space.

The following control statement specifies that the REORG TABLESPACE utility is to reorganize table space DSN8S11D in database DSN8D11A.

```
REORG TABLESPACE DSN8D11A.DSN8S11D
```

Example 2: Reorganizing a table space and specifying the unload data set

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSN8D81A.DSN8S81D. The DD name for the unload data set is UNLD, as specified by the UNLDDN option.

```
//STEP1    EXEC DSNUPROC,UID='IUJLU101.REORG',
//         UTPROC='',
//         SYSTEM='DSN'
//UTPRINT  DD  SYSOUT=*
//UNLD     DD DSN=IUJLU101.REORG.STEP1.UNLD,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTWK01  DD DSN=IUJLU101.REORG.STEP1.SORTWK01,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTWK02  DD DSN=IUJLU101.REORG.STEP1.SORTWK02,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
REORG TABLESPACE (DSN8D11A.DSN8S11D)
      UNLDDN (UNLD)
//*
```

Figure 67. Example REORG TABLESPACE control statement with the UNLDDN option

Example 3: Reorganizing a table space partition

The following control statement specifies that REORG TABLESPACE is to reorganize partition 3 of table space DSN8D11A.DSN8S11E. The SORTDEVT option indicates the device type for the temporary data sets that are to be dynamically allocated by the sort program.

```
REORG TABLESPACE DSN8D11A.DSN8S11E
  PART 3
  SORTDEVT SYSDA
```

Example 4: Reorganizing a table and using parallel index build

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSNDB04.DSN8S81D and to use a parallel index build to rebuild the indexes. The indexes are built in parallel, because more than one index needs to be built and the job allocates the data sets that the sort program needs. Note that you no longer need to specify SORTKEYS; it is the default.

The job allocates the sort work data sets in two groups, which limits the number of pairs of utility subtasks to two. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing. DSNUPROC includes a DD statement that allocates UTPRINT to SYSOUT.

LOG NO specifies that records are not to be logged during the RELOAD phase. This option puts the table space in COPY-pending status.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.REORG',UTPROC='',SYSTEM='DSN'
//SYSREC   DD DSN=SAMPJOB.REORG.STEP1.SYSREC,DISP=(NEW,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//* First group of sort work data sets for parallel index build
//SW01WK01 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW01WK02 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW01WK03 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//* Second group of sort work data sets for parallel index build
//SW02WK01 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW02WK02 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SW02WK03 DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//* Sort work data sets for use by SORTDATA
//SORTWK01 DD  UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SORTWK02 DD  UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SORTWK03 DD  UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND)
//SYSIN    DD *
REORG TABLESPACE DSNDB04.DSN8S11D LOG NO
/*
```

Figure 68. Example REORG TABLESPACE control statement with LOG NO option

Example 5: Reorganizing a table while allowing read-write access

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSNDB04.DSN8S81E and to use a parallel index build to rebuild the indexes. The sort program dynamically allocates sort work data sets. This example does not require UTPRIN*nn* DD statements because it uses DSNUPROC to invoke utility processing. DSNUPROC includes a DD statement that allocates UTPRINT to SYSOUT. The SORTDEVT option indicates the device type for the temporary data sets that are to be dynamically allocated by the sort program. The SHRLEVEL CHANGE option specifies that while the table is being reorganized, users have read-write access. The name of the mapping table is

DSN8MAP. This table is used to map the RIDs of data records in the original copy of the area to the corresponding RIDs in the shadow copy.

```
//SAMPJOB  JOB  ...
//STEP1    EXEC DSNUPROC,UID='SAMPJOB.REORG',UTPROC='',SYSTEM='DSN'
//SYSCOPY  DD UNIT=SYSDA,SPACE=(CYL,(10,20),,,ROUND),
//            DSN=SAMPJOB,COPY,DISP=(NEW,CATLG,CATLG)
//SYSIN    DD *
REORG TABLESPACE DSNDB04.DSN8S11E LOG NO SORTDEVT SYSDA SORTNUM 4
  SHRLEVEL CHANGE MAPPINGTABLE DSN8MAP
/*
```

Example 6: Specifying a deadline for the SWITCH phase while reorganizing a table

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSN8D81A.DSN8S11D. The DEADLINE option indicates that the deadline for start of the SWITCH phase is eight hours from the start of the REORG job. The COPYDDN and RECOVERYDDN options indicate that the utility is to take an image copy of the table space. DB2 is to write the primary image copy at the local site to a data set that is defined by the MYCOPY1 DD statement and to write the primary image copy at the recovery site to a data set that is defined by the MYCOPY2 DD statement. SHRLEVEL REFERENCE indicates that access is restricted during reorganization.

```
REORG TABLESPACE DSN8D11A.DSN8S11D COPYDDN(MYCOPY1)
  RECOVERYDDN(MYCOPY2) SHRLEVEL REFERENCE
  DEADLINE CURRENT TIMESTAMP + 8 HOURS
```

Example 7: Setting a deadline for a REORG TABLESPACE job

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSN8D11A.DSN8S11D. The DEADLINE option indicates that the deadline for the start of the SWITCH phase is eight hours from the start of the REORG job. The name of the mapping table is DSN8810.MAP_TBL. The maximum amount of time for log processing in the read-only (last) iteration of log processing is 240 seconds, as indicated by the MAXRO option. If DB2 is not reading the log quickly enough after the applications write to the log, DB2 drains the write claim class after sending the LONGLOG message to the operator. That draining takes place at least 900 seconds after the LONGLOG message is sent, as indicated by the DELAY option. DB2 is also to take inline image copies for the local site and recovery site, as indicated by the COPYDDN and RECOVERYDDN options.

```
REORG TABLESPACE DSN8D11A.DSN8S11D COPYDDN(MYCOPY1)
  RECOVERYDDN(MYCOPY2) SHRLEVEL CHANGE
  DEADLINE CURRENT TIMESTAMP + 8 HOURS
  MAPPINGTABLE DSN8B10.MAP_TBL MAXRO 240 LONGLOG DRAIN DELAY 900
```

Example 8: Reorganizing a range of table space partitions

The following control statement specifies that REORG TABLESPACE is to reorganize partitions 3 through 5 of table space DSN8D11A.DSN8S11E. The SORTDEVT option indicates the device type for the temporary data sets that are to be dynamically allocated by the sort program. The SHRLEVEL NONE option indicates that while the data is being unloaded, applications can read but can't write. While the data is being reloaded, applications can have read-write access. SHRLEVEL NONE is the default. The COPYDDN option indicates that the utility is to take an image copy of the table space and to write the primary image copy to the data set that is defined by the SYSCOPY DD statement.

```
REORG TABLESPACE DSN8D11A.DSN8S11E
  PART 3:5
    SORTDEVT SYSDA
    SHRLEVEL NONE
    COPYDDN SYSCOPY
```

Example 9: Reorganizing a partition and updating the statistics

The following control statement specifies that REORG TABLESPACE is to reorganize partition 3 of table space DSN8D11A. DSN8S11E. The STATISTICS option indicates that the utility is also to update statistics in the catalog for that partition. Note that the STATISTICS option is not valid for LOB table spaces.

```
REORG TABLESPACE DSN8D11A.DSN8S11E
   STATISTICS PART 3
```

Example 10: Reorganizing a table space and reporting table space and index statistics

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSN8D11A.DSN8S11E. The SORTDATA option indicates that the data is to be unloaded and sorted in clustering order. This option is the default and does not need to be specified. The STATISTICS, TABLE, INDEX, and REPORT YES options indicate that the utility is also to report catalog statistics for all tables in the table space and for all indexes that are defined on those tables. The FREQVAL, NUMCOLS, and COUNT options indicate that DB2 is to collect 10 frequent values on the first key column of the index. UPDATE NONE indicates that the catalog tables are not to be updated. This option requires that REPORT YES also be specified. Because both STATISTICS and INDEX are specified, the utility also collects statistics on the values in the key columns of indexes.

```
REORG TABLESPACE DSN8D11A.DSN8S11E SORTDATA STATISTICS
   TABLE
   INDEX(ALL) FREQVAL NUMCOLS 1
   COUNT 10 REPORT YES UPDATE NONE
```

Example 11: Determining whether a table space should be reorganized

The following control statement specifies that REORG TABLESPACE is to report if the OFFPOSLIMIT and INDREFLIMIT values for partition 11 of table space DBHR5201.TPHR5201 exceed the specified values (11 for OFFPOSLIMIT and 15 for INDREFLIMIT).

```
//STEP1    EXEC DSNUPROC,UID='HUHRU252.REORG2',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSREC   DD DSN=HUHRU252.REORG2.STEP1.SYSREC,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY  DD DSN=HUHRU252.REORG2.STEP1.SYSCOPY,DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//         SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
REORG TABLESPACE DBHR5201.TPHR5201 PART 11
          NOSYSREC
          REPORTONLY
          SHRLEVEL CHANGE MAPPINGTABLE ADMF001.MAP1
          COPYDDN (SYSCOPY)
          OFFPOSLIMIT 11 INDREFLIMIT 15
/*
```

Figure 69. Example REORG TABLESPACE statement with REPORTONLY, OFFPOSLIMIT, and INDREFLIMIT options

On successful completion, DB2 returns output that is similar to the output in the following sample output. This sample output shows that the limits have been met.

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = HUHRU252.REORG2
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  REORG TABLESPACE DBHR5201.TPHR5201 PART 11 NOSYSREC REPORTONLY SHRLEVEL CHANGE
MAPPINGTABLE ADMF001.MAP1 COPYDDN(SYSCOPY) OFFPOSLIMIT 11 INDREFLIMIT 15
DSNU286I  = DSNURLIM - REORG TABLESPACE DBHR5201.TPHR5201 OFFPOSLIMIT SYSINDEXPART ROWS
* CREATOR.IXNAME : ADMF001.IPHR5201
  CREATOR.TBNAME : ADMF001.TBHR5201
  PART:    1 CARDF:  6.758E+03   FAROFFPOSF:   2.892E+03   NEAROFFPOSF:  8.18E+02    STATSTIME: 2003-04-11
13.32.06
DSNU287I  = DSNURLIM - REORG TABLESPACE DBHR5201.TPHR5201 INDREFLIMIT SYSTABLEPART ROWS
  DBNAME  .TSNAME   PART          CARD  FARINDREF NEARINDREF      STATSTIME
  DBHR5201.TPHR5201     1         6758          0          0 2003-04-11-13.32.06

DSNU289I  = DSNURLIM -  REORG LIMITS HAVE BEEN MET
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 70. Sample output showing that REORG limits have been met

Example 12: Conditionally reorganizing a table space

In the following example, the RUNSTATS utility control statement specifies that the utility is to update space statistics in the catalog for table space DBHR5201.TPHR5201. This RUNSTATS job ensures that the space statistics for this table space are current. The subsequent REORG TABLESPACE control statement specifies that if any of the values for OFFPOSLIMIT or INDREFLIMIT exceed 9, the utility is to reorganize the table space.

```
//*****************************************************************
//* COMMENT: UPDATE STATISTICS
//*****************************************************************
//STEP1    EXEC DSNUPROC,UID='HUHRU252.REORG1',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSREC   DD DSN=HUHRU252.REORG1.STEP1.SYSREC,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//         SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
RUNSTATS TABLESPACE DBHR5201.TPHR5201
      UPDATE SPACE
/*
//*****************************************************************
//* COMMENT: REORG THE TABLESPACE
//*****************************************************************
//STEP2    EXEC DSNUPROC,UID='HUHRU252.REORG1',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSREC   DD DSN=HUHRU252.REORG1.STEP1.SYSREC,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY1 DD DSN=HUHRU252.REORG1.STEP1.SYSCOPY1,
//         DISP=(MOD,CATLG,CATLG),UNIT=SYSDA,
//         SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
REORG TABLESPACE DBHR5201.TPHR5201
      SHRLEVEL CHANGE MAPPINGTABLE MAP1
      COPYDDN(SYSCOPY1)
      OFFPOSLIMIT 9 INDREFLIMIT 9
/*
```

Figure 71. Example of conditionally reorganizing a table

On successful completion, DB2 returns output for the REORG TABLESPACE job that is similar to the output in the following sample output.

```
DSNU050I    DSNUGUTC -  REORG TABLESPACE DBHR5201.TPHR5201 SHRLEVEL CHANGE MAPPINGTABLE
MAP1 COPYDDN(SYSCOPY1)
OFFPOSLIMIT 9 INDREFLIMIT 9
DSNU286I  = DSNURLIM - REORG TABLESPACE DBHR5201.TPHR5201 OFFPOSLIMIT SYSINDEXPART ROWS
* CREATOR.IXNAME : ADMF001.IPHR5201
CREATOR.TBNAME : ADMF001.TBHR5201
   PART:   1 CARDF:  3.6E+01     FAROFFPOSF:   0.0E0       NEAROFFPOSF:  1.2E+01
STATSTIME: 2002-05-28-16.22.18
  CREATOR.IXNAME : ADMF001.IPHR5201
  CREATOR.TBNAME : ADMF001.TBHR5201
   PART:   2 CARDF:  5.0E+00     FAROFFPOSF:   0.0E0       NEAROFFPOSF:  0.0E0
STATSTIME: 2002-05-28-16.22.18
...
* CREATOR.IXNAME : ADMF001.IPHR5201
  CREATOR.TBNAME : ADMF001.TBHR5201
   PART:  11 CARDF:  6.758E+03   FAROFFPOSF:   2.892E+03   NEAROFFPOSF:  8.18E+02
STATSTIME: 2002-05-28-16.22.18
DSNU287I  = DSNURLIM - REORG TABLESPACE DBHR5201.TPHR5201 INDREFLIMIT SYSTABLEPART ROWS
  DBNAME  .TSNAME   PART         CARD  FARINDREF NEARINDREF      STATSTIME
  DBHR5201.TPHR5201    1           36          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    2            5          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    3           54          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    4           30          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    5           21          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    6            5          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    7            4          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    8           35          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201    9           25          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201   10            1          0          0 2002-05-28-16.22.18
  DBHR5201.TPHR5201   11         6758          0          0 2002-05-28-16.22.18
DSNU289I  = DSNURLIM -  REORG LIMITS HAVE BEEN MET
```

```
DSNU290I  = DSNURLIM -  REORG WILL BE PERFORMED
DSNU252I    DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=6985 FOR
TABLESPACE DBHR5201.TPHR5201
DSNU250I    DSNUGSRT - UNLOAD PHASE COMPLETE, ELAPSED TIME=00:00:01
DSNU304I  = DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=6985 FOR TABLE
ADMF001.TBHR5201
DSNU302I    DSNURILD - (RE)LOAD PHASE STATISTICS - NUMBER OF INPUT RECORDS PROCESSED=6985
DSNU300I    DSNURILD - (RE)LOAD PHASE COMPLETE, ELAPSED TIME=00:00:29
DSNU042I    DSNUGSOR - SORT PHASE STATISTICS -
                       NUMBER OF RECORDS=34925
                       ELAPSED TIME=00:00:00

DSNU348I  = DSNURBXA - BUILD PHASE STATISTICS - NUMBER OF KEYS=36 FOR INDEX ADMF001.IPHR5201  PART 1
DSNU348I  = DSNURBXA - BUILD PHASE STATISTICS - NUMBER OF KEYS=5 FOR INDEX ADMF001.IPHR5201  PART 2
...
DSNU349I  = DSNURBXA - BUILD PHASE STATISTICS - NUMBER OF KEYS=6985 FOR INDEX ADMF001.IUHR5210
DSNU258I    DSNURBXD - BUILD PHASE STATISTICS - NUMBER OF INDEXES=5
DSNU259I    DSNURBXD - BUILD PHASE COMPLETE, ELAPSED TIME=00:00:18
DSNU386I    DSNURLGD - LOG PHASE STATISTICS. NUMBER OF ITERATIONS = 1, NUMBER OF LOG
RECORDS = 194
DSNU385I    DSNURLGD - LOG PHASE COMPLETE, ELAPSED TIME = 00:01:10
DSNU400I    DSNURBID - COPY PROCESSED FOR TABLESPACE DBHR5201.TPHR5201
                       NUMBER OF PAGES=1073
                       AVERAGE PERCENT FREE SPACE PER PAGE = 14.72
                       PERCENT OF CHANGED PAGES =100.00
                       ELAPSED TIME=00:01:58
DSNU387I    DSNURSWT - SWITCH PHASE COMPLETE, ELAPSED TIME = 00:01:05
DSNU428I    DSNURSWT - DB2 IMAGE COPY SUCCESSFUL FOR TABLESPACE DBHR5201.TPHR5201
```

Figure 72. Sample REORG output for conditional REORG

Example 13: Reorganizing a table space after waiting for SQL statements to complete.

The following control statement specifies that REORG TABLESPACE is to reorganize the table space in the REORG_TBSP list, which is defined in the preceding LISTDEF utility control statement. Before reorganizing the table space, REORG TABLESPACE is to wait for 30 seconds for SQL statements to finish adding or changing data. This interval is indicated by the DRAIN_WAIT option. If the SQL statements do not finish, the utility is to try again up to four times, as indicated by the RETRY option. The utility is to wait 10 seconds between retries, as indicated by the RETRY_DELAY option.

The TEMPLATE utility control statements define the data set characteristics for the data sets that are to be dynamically allocated during the REORG TABLESPACE job. The OPTIONS utility control statement indicates that the TEMPLATE statements and LISTDEF statement are to run in PREVIEW mode.

```
//STEP1    EXEC DSNUPROC,UID='HUHRU257.REORG',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//UTPRINT  DD  SYSOUT=*
//SYSIN    DD *
   OPTIONS PREVIEW
   TEMPLATE CPYTMP UNIT(SYSDA)
                   DSN(HUHRU257.REORG.T&TI..SYSCOPY1)
   TEMPLATE SREC
            UNIT(SYSDA) DISP(NEW,CATLG,CATLG)
            DSN(HUHRU257.REORG.&ST..SREC)
   TEMPLATE SDISC
            UNIT(SYSDA) DISP(NEW,CATLG,CATLG)
            DSN(HUHRU257.REORG.&ST..SDISC)
   TEMPLATE SPUNCH
            UNIT(SYSDA) DISP(NEW,CATLG,CATLG)
                 DSN(HUHRU257.REORG.&ST..SPUNCH)
   LISTDEF REORG_TBSP INCLUDE TABLESPACE DBHR5701.TPHR5701
   OPTIONS OFF
   REORG TABLESPACE LIST REORG_TBSP
       DRAIN_WAIT 30    RETRY 4     RETRY_DELAY 10
          STATISTICS
          TABLE (ALL) SAMPLE 60
          INDEX (ALL FREQVAL NUMCOLS 2 COUNT 15)
          SHRLEVEL CHANGE MAPPINGTABLE MAP5702
          LONGLOG DRAIN MAXRO DEFER DELAY 30
          COPYDDN (CPYTMP)
          SORTDEVT SYSDA SORTNUM 8
          PUNCHDDN SPUNCH
          DISCARDDN SDISC
                 UNLDDN SREC
```

Figure 73. Example of reorganizing a table space by using DRAIN WAIT, RETRY, and RETRY_DELAY

On successful completion, DB2 returns output similar to the output in the following sample output.

```
DSNU000I    280 14:54:37.27 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = HUHRU257.REORG
DSNU1044I   280 14:54:37.43 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    280 14:54:37.45 DSNUGUTC -  OPTIONS PREVIEW
DSNU1000I   280 14:54:37.45 DSNUZODR - PROCESSING CONTROL STATEMENTS IN PREVIEW MODE
DSNU1035I   280 14:54:37.45 DSNUZODR - OPTIONS STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.45 DSNUGUTC -  TEMPLATE CPYTMP UNIT(SYSDA) DSN(HUHRU257.REORG.STEP12.SYSCOPY1)
DSNU1035I   280 14:54:37.45 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  TEMPLATE SREC UNIT(SYSDA) DISP(NEW, CATLG, CATLG) DSN(
HUHRU257.REORG.&ST..SREC)
DSNU1035I   280 14:54:37.46 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  TEMPLATE SDISC UNIT(SYSDA) DISP(NEW, CATLG, CATLG) DSN(
HUHRU257.REORG.&ST..SDISC)
DSNU1035I   280 14:54:37.46 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  TEMPLATE SPUNCH UNIT(SYSDA) DISP(NEW, CATLG, CATLG) DSN(
HUHRU257.REORG.&ST..SPUNCH)
DSNU1035I   280 14:54:37.46 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  TEMPLATE SUT1 UNIT(SYSDA) DISP(NEW, DELETE, CATLG) DSN(
HUHRU257.REORG.&ST..SUT1)
DSNU1035I   280 14:54:37.46 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  TEMPLATE SOUT UNIT(SYSDA) DISP(NEW, DELETE, CATLG) DSN(
HUHRU257.REORG.&ST..SOUT)
DSNU1035I   280 14:54:37.46 DSNUJTDR - TEMPLATE STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.46 DSNUGUTC -  LISTDEF REORG_TBSP INCLUDE TABLESPACE DBHR5701.TPHR5701
DSNU1035I   280 14:54:37.47 DSNUILDR - LISTDEF STATEMENT PROCESSED SUCCESSFULLY
DSNU1020I @ 280 14:54:37.47 DSNUILSA - EXPANDING LISTDEF REORG_TBSP
DSNU1021I @ 280 14:54:37.47 DSNUILSA -   PROCESSING INCLUDE CLAUSE TABLESPACE DBHR5701.TPHR5701
DSNU1022I @ 280 14:54:37.47 DSNUILSA - CLAUSE IDENTIFIES 1 OBJECTS
DSNU1023I @ 280 14:54:37.47 DSNUILSA - LISTDEF REORG_TBSP CONTAINS 1 OBJECTS
DSNU1010I   280 14:54:37.47 DSNUGPVV - LISTDEF REORG_TBSP EXPANDS TO THE FOLLOWING OBJECTS:
       LISTDEF REORG_TBSP -- 00000001 OBJECTS
         INCLUDE TABLESPACE DBHR5701.TPHR5701
DSNU050I    280 14:54:37.47 DSNUGUTC -  OPTIONS OFF
DSNU1035I   280 14:54:37.47 DSNUZODR - OPTIONS STATEMENT PROCESSED SUCCESSFULLY
DSNU050I    280 14:54:37.47 DSNUGUTC -  REORG TABLESPACE LIST REORG_TBSP SHRLEVEL CHANGE MAPPINGTABLE MAP5702
```

```
LONGLOG DRAIN MAXRO DEFER DELAY 30 DRAIN_WAIT 30 RETRY 4 RETRY_DELAY 10 COPYDDN(CPYTMP) SORTKEYS SORTDEVT SYSDA
SORTNUM 8 PUNCHDDN SPUNCH DISCARDDN SDISC UNLDDN SREC WORKDDN(SUT1, SOUT) STATISTICS TABLE(ALL) SAMPLE 60 INDEX(ALL
 KEYCARD FREQVAL NUMCOLS 2 COUNT 15)
DSNU1033I   280 14:54:37.48 DSNUGULM - PROCESSING LIST ITEM: TABLESPACE DBHR5701.TPHR5701
DSNU1038I   280 14:54:42.97 DSNUGDYN - DATASET ALLOCATED.  TEMPLATE=CPYTMP
                DDNAME=SYS00001
                DSN=HUHRU257.REORG.STEP12.SYSCOPY1
DSNU397I    280 14:54:43.01 DSNURPCT - NUMBER OF TASKS CONSTRAINED BY VIRTUAL STORAGE
DSNU397I    280 14:54:43.01 DSNURPCT - NUMBER OF TASKS CONSTRAINED BY CPUS
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 1
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 2
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 3
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 4
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 5
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 6
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 7
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 8
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 9
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=0 FOR TABLESPACE
DBHR5701.TPHR5701 PART 10
DSNU251I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=2520 FOR TABLESPACE
DBHR5701.TPHR5701 PART 11
DSNU252I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS UNLOADED=2520 FOR TABLESPACE
DBHR5701.TPHR5701
DSNU250I    280 14:54:43.40 DSNUGSRT - UNLOAD PHASE COMPLETE, ELAPSED TIME=00:00:00
DSNU395I    280 14:54:43.95 DSNURPIB - INDEXES WILL BE BUILT IN PARALLEL, NUMBER OF TASKS = 6
DSNU397I    280 14:54:43.95 DSNURPIB - NUMBER OF TASKS CONSTRAINED BY VIRTUAL STORAGE
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=1
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=2
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=3
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=4
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=5
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=6
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=7
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=8
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701 PART=9
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=0 FOR TABLE ADMF001.TBHR5701
PART=10
DSNU303I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=2520 FOR TABLE ADMF001.TBHR5701
PART=11
DSNU304I  @ 280 14:55:42.47 DSNURWT - (RE)LOAD PHASE STATISTICS - NUMBER OF RECORDS=2520 FOR TABLE ADMF001.TBHR5701
DSNU302I    280 14:55:42.48 DSNURILD - (RE)LOAD PHASE STATISTICS - NUMBER OF INPUT RECORDS PROCESSED=2520
DSNU300I    280 14:55:42.48 DSNURILD - (RE)LOAD PHASE COMPLETE, ELAPSED TIME=00:00:59
DSNU394I  @ 280 14:55:42.69 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IXHR5702
DSNU394I  @ 280 14:55:42.77 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IXHR5704
DSNU394I  @ 280 14:55:42.83 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IXHR5706
DSNU393I  @ 280 14:55:42.63 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IPHR5701  PART
11
DSNU394I  @ 280 14:55:42.73 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IUHR5710
DSNU394I  @ 280 14:55:42.82 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IXHR5703
DSNU394I  @ 280 14:55:42.94 DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=2520 FOR INDEX ADMF001.IXHR5705
DSNU391I    280 14:55:43.15 DSNURPTB - SORTBLD PHASE STATISTICS. NUMBER OF INDEXES = 7
DSNU392I    280 14:55:43.15 DSNURPTB - SORTBLD PHASE COMPLETE, ELAPSED TIME = 00:00:00
DSNU386I    280 14:57:33.94 DSNURLGD - LOG PHASE STATISTICS. NUMBER OF ITERATIONS = 23, NUMBER OF LOG RECORDS = 0
DSNU385I    280 14:57:33.94 DSNURLGD - LOG PHASE COMPLETE, ELAPSED TIME = 00:01:50
DSNU400I    280 14:57:33.95 DSNURBID - COPY PROCESSED FOR TABLESPACE DBHR5701.TPHR5701
                NUMBER OF PAGES=394
                AVERAGE PERCENT FREE SPACE PER PAGE = 13.70
                PERCENT OF CHANGED PAGES =100.00
                ELAPSED TIME=00:02:50
DSNU387I    280 14:57:35.53 DSNURSWT - SWITCH PHASE COMPLETE, ELAPSED TIME = 00:00:01
DSNU428I    280 14:57:35.54 DSNURSWT - DB2 IMAGE COPY SUCCESSFUL FOR TABLESPACE DBHR5701.TPHR5701
DSNU610I  @ 280 14:57:36.78 DSNUSUTP - SYSTABLEPART CATALOG UPDATE FOR DBHR5701.TPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:36.78 DSNUSUPT - SYSTABSTATS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:36.85 DSNUSUPC - SYSCOLSTATS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:36.85 DSNUSUTB - SYSTABLES CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:36.92 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:36.93 DSNUSUTS - SYSTABLESPACE CATALOG UPDATE FOR DBHR5701.TPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.42 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.44 DSNUSUPI - SYSINDEXSTATS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
```

```
DSNU610I  @ 280 14:57:37.45 DSNUSUPC - SYSCOLSTATS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.45 DSNUSUPD - SYSCOLDISTSTATS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.46 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  @ 280 14:57:37.46 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  @ 280 14:57:37.47 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
SNU610I  @ 280 14:57:37.47 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  @ 280 14:57:37.48 DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU610I  @ 280 14:57:37.48 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.48 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.54 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  @ 280 14:57:37.54 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  @ 280 14:57:37.57 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  @ 280 14:57:37.57 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  @ 280 14:57:37.60 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU610I  @ 280 14:57:37.60 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU610I  @ 280 14:57:37.63 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  @ 280 14:57:37.63 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  @ 280 14:57:37.66 DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU610I  @ 280 14:57:37.66 DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU610I  @ 280 14:57:37.71 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  @ 280 14:57:37.71 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  @ 280 14:57:37.72 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  @ 280 14:57:37.72 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU610I  @ 280 14:57:37.73 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  @ 280 14:57:37.74 DSNUSUCD - SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU620I  @ 280 14:57:37.74 DSNUSEOF - RUNSTATS CATALOG TIMESTAMP = 2010-10-07-14.54.43.844498
DSNU010I    280 14:57:42.23 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0

DSNU394I  = DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=331 FOR INDEX ADMF001.IXHR5706
DSNU394I  = DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=331 FOR INDEX ADMF001.IXHR5705
DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5702 SUCCESSFUL
 DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5705 SUCCESSFUL
DSNU620I  = DSNURDRI - RUNSTATS CATALOG TIMESTAMP = 2002-08-05-16.25.21.292235
DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5703 SUCCESSFUL
DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5706 SUCCESSFUL
DSNU620I  = DSNURDRI - RUNSTATS CATALOG TIMESTAMP = 2002-08-05-16.25.22.288665
DSNU393I  = DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=331 FOR INDEX ADMF001.IPHR5701  PART 11
DSNU394I  = DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=331 FOR INDEX ADMF001.IPHR5701
DSNU394I  = DSNURBXA - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=331 FOR INDEX ADMF001.IXHR5704
DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  = DSNUSUPI -       SYSINDEXSTATS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  = DSNUSUPD -         SYSCOLDISTSTATS CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  = DSNUSUPC -         SYSCOLSTATS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IPHR5701 SUCCESSFUL
DSNU610I  = DSNUSUIP -   SYSINDEXPART CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU610I  = DSNUSUIX -     SYSINDEXES CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU610I  = DSNUSUCO -       SYSCOLUMNS CATALOG UPDATE FOR ADMF001.TBHR5701 SUCCESSFUL
DSNU610I  = DSNUSUCD -       SYSCOLDIST CATALOG UPDATE FOR ADMF001.IXHR5704 SUCCESSFUL
DSNU620I  = DSNURDRI - RUNSTATS CATALOG TIMESTAMP = 2002-08-05-16.25.20.886803
DSNU391I    DSNURPTB - SORTBLD PHASE STATISTICS. NUMBER OF INDEXES = 7
DSNU392I    DSNURPTB - SORTBLD PHASE COMPLETE, ELAPSED TIME = 00:00:04
DSNU377I  = DSNURLOG - IN REORG WITH SHRLEVEL CHANGE, THE LOG IS
BECOMING LONG, MEMBER=        , UTILID=HUHRU257.REORG
DSNU377I  = DSNURLOG - IN REORG WITH SHRLEVEL CHANGE, THE LOG IS
BECOMING LONG, MEMBER=        , UTILID=HUHRU257.REORG
...
DSNU377I  = DSNURLOG - IN REORG WITH SHRLEVEL CHANGE, THE LOG IS
BECOMING LONG, MEMBER=        , UTILID=HUHRU257.REORG
DSNU1122I = DSNURLOG - JOB T3161108 PERFORMING REORG
WITH UTILID HUHRU257.REORG UNABLE TO DRAIN DBHR5701.TPHR5701.
RETRY 1 OF 4 WILL BE ATTEMPTED IN 10 SECONDS
 DSNU1122I = DSNURLOG - JOB T3161108 PERFORMING REORG
 WITH UTILID HUHRU257.REORG UNABLE TO DRAIN DBHR5701.TPHR5701.
RETRY 2 OF 4 WILL BE ATTEMPTED IN 10 SECONDS
DSNU386I    DSNURLGD - LOG PHASE STATISTICS. NUMBER OF ITERATIONS = 32, NUMBER OF LOG RECORDS = 2288
```

```
DSNU385I    DSNURLGD - LOG PHASE COMPLETE, ELAPSED TIME = 00:03:43
DSNU400I    DSNURBID - COPY PROCESSED FOR TABLESPACE DBHR5701.TPHR5701
                       NUMBER OF PAGES=377
                      AVERAGE PERCENT FREE SPACE PER PAGE =  5.42
                       PERCENT OF CHANGED PAGES =100.00
                       ELAPSED TIME=00:04:02
DSNU387I    DSNURSWT - SWITCH PHASE COMPLETE, ELAPSED TIME = 00:00:02
DSNU428I    DSNURSWT - DB2 IMAGE COPY SUCCESSFUL FOR TABLESPACE DBHR5701.TPHR5701
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 74. Sample output of REORG TABLESPACE job with DRAIN WAIT, RETRY, and RETRY_DELAY options

Example 14: Using a mapping table

In the following example, a mapping table and mapping table index are created. Then, a REORG TABLESPACE job uses the mapping table, and finally the mapping table is dropped. Some parts of this job use the EXEC SQL utility to execute dynamic SQL statements.

The first EXEC SQL control statement contains the SQL statements that create a mapping table that is named MYMAPPING_TABLE. The second EXEC SQL control statement contains the SQL statements that create mapping index MYMAPPING_INDEX on the table MYMAPPING_TABLE.

The REORG TABLESPACE control statement then specifies that the REORG TABLESPACE utility is to reorganize table space DSN8D81P.DSN8S81C and to use mapping table MYMAPPING_TABLE.

Finally, the third EXEC SQL statement contains the SQL statements that drop MYMAPPING_TABLE.

GUPI

```
EXEC SQL
  CREATE TABLE MYMAPPING_TABLE
    (TYPE         CHAR( 01 ) NOT NULL,
     SOURCE_RID   CHAR( 05 ) NOT NULL,
     TARGET_XRID  CHAR( 09 ) NOT NULL,
     LRSN         CHAR( 06 ) NOT NULL)
   IN DSN8D81P.DSN8S81Q
   CCSID EBCDIC
ENDEXEC
EXEC SQL
  CREATE UNIQUE INDEX MYMAPPING_INDEX
   ON MYMAPPING_TABLE
    (SOURCE_RID ASC,
     TYPE,
     TARGET_XRID,
     LRSN)
   USING STOGROUP DSN8G710
   PRIQTY 120 SECQTY 20
   ERASE NO
   BUFFERPOOL BP0
   CLOSE NO
ENDEXEC
REORG TABLESPACE DSN8D81P.DSN8S81C
 COPYDDN(COPYDDN)
 SHRLEVEL CHANGE
 DEADLINE CURRENT_TIMESTAMP+8 HOURS
 MAPPINGTABLE MYMAPPING_TABLE
 MAXRO 240 LONGLOG DRAIN DELAY 900
 SORTDEVT SYSDA SORTNUM 4
```

```
 STATISTICS TABLE(ALL)
            INDEX(ALL)
EXEC SQL
  DROP TABLE MYMAPPING_TABLE
ENDEXEC
```

GUPI

Figure 75. Example of creating and using a mapping table.

Example 15: Discarding records from one table while reorganizing a table space

The following control statement specifies that REORG TABLESPACE is to reorganize table space DSN8D51A.DSN8S51E. During reorganization, records in table DSN8510.EMP are discarded if they have the value D11 in the WORKDEPT field. This discard criteria is specified in the WHEN clause that follows the DISCARD option. Because a SYSDISC DD statement is included in the JCL, any discarded rows are to be written to the data set that is identified by this DD statement.

The COPYDDN option specifies that during the REORG, DB2 is also to take an inline copy of the table space. This image copy is to be written to the data set that is identified by the SYSCOPY DD statement.

```
//REORGDIS EXEC DSNUPROC,TIME=1440,
 //         UTPROC='',
 //         SYSTEM='DSN',UID='REORGDIS.EMP'
 //SYSREC   DD DISP=(NEW,CATLG,CATLG),
 //         DSN=SYSADM.REORGDIS.SYSREC,
 //         UNIT=SYSDA,SPACE=(TRK,(15,15))
 //SYSDISC  DD DISP=(NEW,CATLG,CATLG),
 //         DSN=SYSADM.REORGDIS.SYSDISC,
 //         UNIT=SYSDA,SPACE=(TRK,(15,15))
 //SYSPUNCH DD DISP=(NEW,CATLG,CATLG),
 //         DSN=SYSADM.REORGDIS.SYSPUNCH,
 //         UNIT=SYSDA,SPACE=(TRK,(15,15))
 //SYSCOPY  DD DISP=(NEW,CATLG,CATLG),
 //         UNIT=SYSDA,SPACE=(TRK,(30,30)),
 //         DSN=SYSADM.DSN8D51A.DSN8S51E.COPY
 //SYSIN    DD *
     REORG TABLESPACE
      DSN8D81A.DSN8S81E
      DISCARD
      FROM TABLE DSN8810.EMP
      WHEN (WORKDEPT = 'D11')
      SHRLEVEL NONE COPYDDN SYSCOPY
```

Figure 76. Example REORG statement that specifies discard criteria

Example 16: Discarding records from multiple tables while reorganizing a table space

The following control statement specifies that REORG TABLESPACE is to reorganize table space DBKC0501.TLKC0501. During reorganization, the following records are discarded:

- Records in table TBKC0501 that have a value in the QT_INV_TRANSACTION column that is less than or equal to 700, and a value in the NO_DEPT column that is equal to X'33303230'.

- Records in table TBKC0502 that have a value in the NO_WORK_CENTER column that is equal to either X'333031303120' or X'333032303620'.

This discard criteria is specified with the DISCARD option. Any discarded rows are to be written to the SYSDISC data set, as specified by the DISCARDDN option.

```
//STEP1    EXEC DSNUPROC,UID='IUKCU105.REORG2',
//         UTPROC='',
//         SYSTEM='SSTR'
//UTPRINT  DD  SYSOUT=*
//SYSDISC  DD DSN=IUKCU105.REORG2.STEP1.SYSDISC,
//         DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(2000,(20,20),,,ROUND),
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=2400)
//SYSREC   DD DSN=IUKCU105.REORG2.STEP1.SYSREC,
//         DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY  DD DSN=IUKCU105.REORG2.STEP1.SYSCOPY,
//         DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//LOADSTMT DD DSN=IUKCU105.REORG2.STEP1.SYSPUNCH,
//         DISP=(MOD,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
    REORG TABLESPACE DBKC0501.TLKC0501 SHRLEVEL REFERENCE
          PUNCHDDN LOADSTMT DISCARDDN SYSDISC
          UNLOAD CONTINUE
          DISCARD
          FROM TABLE TBKC0501
             WHEN (QT_INV_TRANSACTION <= 700 AND
                   NO_DEPT = X'33303230')
          FROM TABLE TBKC0502
           WHEN (NO_WORK_CENTER = X'333031303120' OR
                 NO_WORK_CENTER = X'333032303620')
/*
```

Figure 77. Example REORG statement that specifies discard criteria for several tables

Example 17: Reorganizing only those partitions that are in REORG-pending status

The following control statement specifies that REORG TABLESPACE is to reorganize only those partitions of table space DBKQAA01.TPKQAA01 that are in the range from 2 to 10 and are in REORG-pending status.

```
//STEP1    EXEC DSNUPROC,UID='JUKQU1AA.REORG6',
//            UTPROC='',SYSTEM='SSTR'
//SYSREC   DD DSN=JUKQU1AA.REORG6.STEP1.SYSREC,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSCOPY  DD DSN=JUKQU1AA.REORG6.STEP1.SYSCOPY,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSUT1   DD DSN=JUKQU1AA.REORG6.STEP1.SYSUT1,
//         DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SORTOUT  DD DSN=JUKQU1AA.REORG6.STEP1.SORTOUT,
//         DISP=(MOD,DELETE,CATLG),UNIT=SYSDA,
//         SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD *
    REORG TABLESPACE DBKQAA01.TPKQAA01 SCOPE PENDING PART 2:10
/*
```

Figure 78. Example REORG TABLESPACE statement with SCOPE PENDING

Example 18: Creating a FlashCopy image copy with REORG TABLESPACE

The following REORG TABLESPACE utility control statement reorganizes table space DSN8SA1D and creates a FlashCopy image copy.

```
//SYSADMA JOB (ACCOUNT),'NAME',NOTIFY=&SYSUID
//*
//UTIL EXEC DSNUPROC,SYSTEM=VA1A,UID='TEMP',UTPROC=''
//DSNUPROC.SYSREC DD DSN=SYSOPS.DSNAME,
// DISP=(NEW,DELETE),
// SPACE=(CYL,(20,20),RLSE),
// UNIT=SYSDA,VOL=SER=SCR03
//DSNUPROC.SYSUT1 DD DSN=SYSOPS.SYSUT1,
// DISP=(NEW,DELETE,DELETE),
// SPACE=(CYL,(9,90),RLSE),
// UNIT=SYSDA,VOL=SER=SCR03
//DSNUPROC.SYSIN DD *
LISTDEF COPY_LIST INCLUDE TABLESPACE DSN8DA1A.DSN8SA1D
TEMPLATE SCOPY UNIT(SYSDA) DISP(NEW,CATLG,DELETE)
DSN(DSNT1.&DB..&TS..CPY1.D&TIME.)
TEMPLATE FCOPY UNIT(SYSDA) DISP(NEW,CATLG,DELETE)
DSN(DSNFC.&DB..&TS..P&PA..D&TIME.)
REORG TABLESPACE LIST COPY_LIST SHRLEVEL REFERENCE FLASHCOPY YES
FCCOPYDDN(FCOPY) COPYDDN(SCOPY)
```

Example 19: Reorganizing only clone tables

The REORG TABLESPACE control statement indicates that REORG TABLESPACE is to reorganize only clone tables from the specified table spaces.

```
REORG TABLESPACE DBKQBS01.TPKQBS01 CLONE
```

Related reference:

CREATE INDEX (DB2 SQL)

CREATE TABLE (DB2 SQL)

DROP (DB2 SQL)

DB2 Sort

Related information:

DFSORT Application Programming Guide

Chapter 30. REPAIR

The REPAIR online utility repairs data. The data can be your own data or data that you would not normally access, such as space map pages and index entries.

You use REPAIR to replace invalid data with valid data. Be extremely careful when using REPAIR. Improper use can damage the data even further.

You can use the REPAIR utility to:

- Test database definitions (DBDs)
- Repair DBDs
- Reset a pending status on a table space or index
- Verify the contents of data areas in table spaces and indexes
- Replace the contents of data areas in table spaces and indexes
- Delete a single row from a table space
- Produce a hexadecimal dump of an area in a table space or index
- Delete an entire LOB from a LOB table space
- Dump LOB pages
- Rebuild object descriptors (OBDs) for a LOB table space
- Manage version numbers
- Turn on or off Persistent Read Only (PRO) restricted status for table space partitions
- Check for and fix any inconsistencies between the information in the catalog and the data. (Specifically REPAIR can check the values for DBID, PSID, OBID, SEGSIZE, PAGESIZE, table space type, table schema, record format, RBA format, data version number, and the hash data page.)

Output

The output from the REPAIR utility can consist of one or more modified pages in the specified DB2 table space or index and a dump of the contents.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- REPAIR privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- DATAACCESS authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute REPAIR, but only on a table space in the DSNDB01 or DSNDB06 database.

To execute REPAIR with the DBD option, you must use a privilege set that includes SYSADM, SYSCTRL, or installation SYSOPR authority.

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REPAIR should be used only by a person that is knowledgeable in DB2 and your data. Grant REPAIR authorization only to the appropriate people.

Execution phases of REPAIR

The phases for REPAIR are:

Phase Description

UTILINIT
Performs initialization

REPAIR
Repairs data

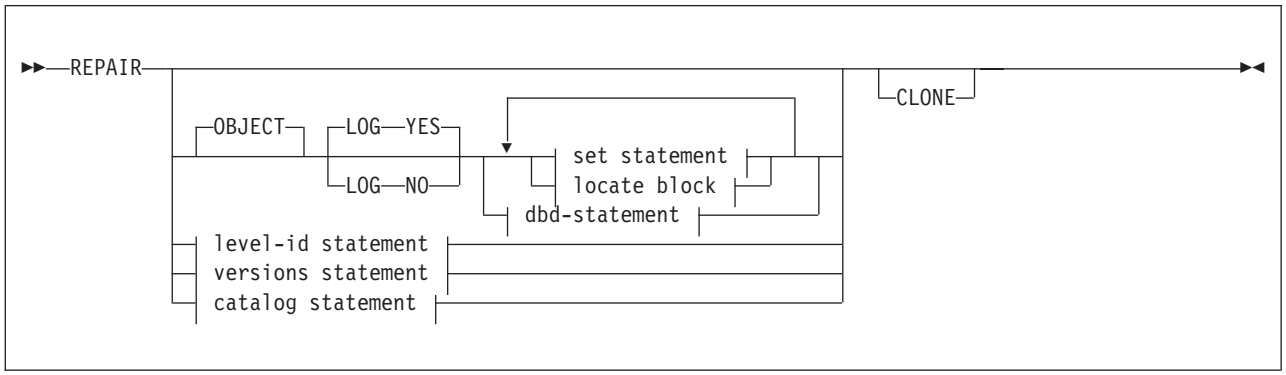
UTILTERM
Performs cleanup

Syntax and options of the REPAIR control statement

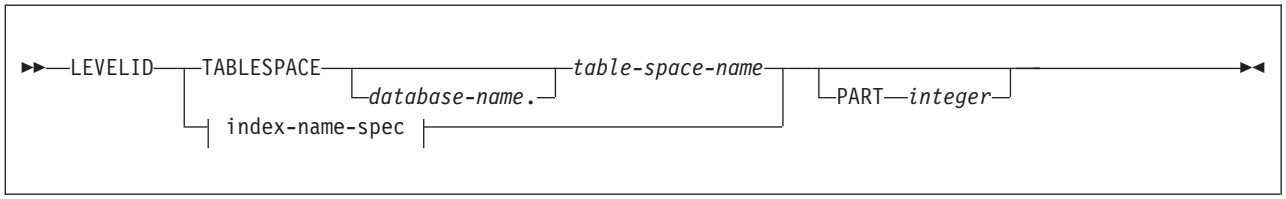
The REPAIR utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

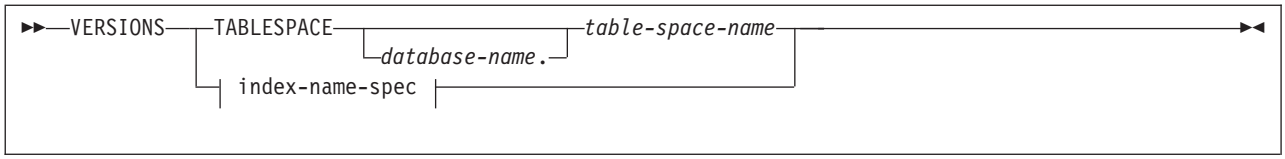
REPAIR syntax diagram



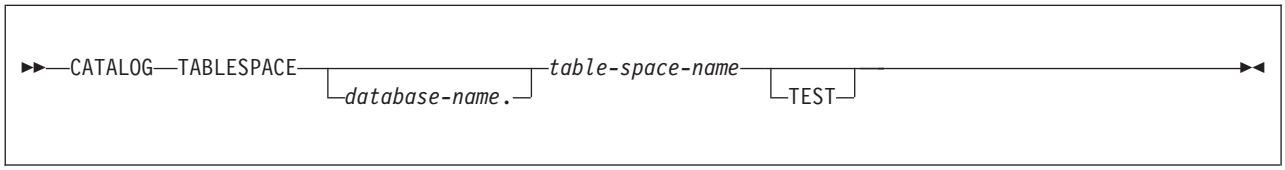
level-id statement:



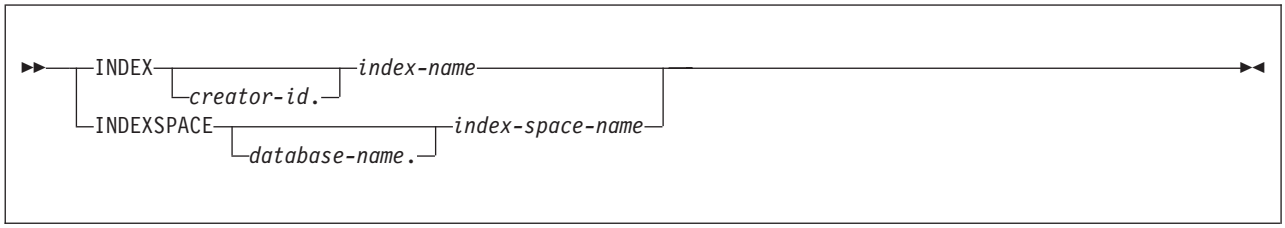
versions statement:



catalog statement:



index-name-spec:



REPAIR option descriptions

OBJECT
Indicates that an object is to be repaired. This keyword is optional.

LOG
Indicates whether the changes that REPAIR makes are to be logged. If the changes are to be logged, they are applied again if the data is recovered.

YES
Indicates that the changes are to be logged.

REPAIR LOG YES cannot override the LOG NO attribute of a table space.

NO Indicates that the changes are not to be logged. You cannot use this option with a DELETE statement.

REPAIR LOG NO can override the LOG YES attribute of a table space.

LEVELID
Indicates that the level identifier of the named table space, table space partition, index, or index space partition is to be reset to a new identifier. Use LEVELID to accept the use of a down-level data set. You cannot specify multiple LEVELID keywords in the same REPAIR control statement.

You cannot use LEVELID with a table space, table space partition, index, or index space partition that has outstanding indoubt log records or pages in the logical page list (LPL).

Attention: Accepting the use of a down-level data set might cause data inconsistencies. Problems with inconsistent data that result from resetting the level identifier are the responsibility of the user.

TABLESPACE *database-name.table-space-name*
Specifies the table space (and, optionally, the database to which it belongs) whose level identifier is to be reset (if you specify LEVELID) or whose version identifier is to be updated (if you specify VERSIONS).

database-name
Specifies the name of the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name
Specifies the name of the table space.

INDEX
Specifies the index whose level identifier is to be reset (if you specify LEVELID) or whose version identifier is to be updated (if you specify VERSIONS).

creator-id
Specifies the creator of the index. Specifying this qualifier is optional.

index-name
Specifies the name of the index. Enclose the index name in quotation marks if the name contains a blank.

You can specify either INDEX or INDEXSPACE to identify an index. To specify multiple indexes, repeat the keyword.

INDEXSPACE
Specifies the index space for the index whose level identifier is to be reset (if you specify LEVELID) or whose version identifier is to be updated (if you specify VERSIONS). You can obtain the index space name for an index from the SYSIBM.SYSINDEXES catalog table. The index space name must be qualified.

database-name
Specifies the name of the database to which the index space belongs.

index-space-name
Specifies the name of the index space.

You can specify either INDEX or INDEXSPACE to identify an index. To specify multiple indexes, repeat the keyword.

PART
Identifies a partition of the table space or index (including a partition of a data-partitioned secondary index).

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

VERSIONS

The VERSIONS option is deprecated, and the alternative is running REPAIR CATALOG.Updates the version information in the catalog and directory for the specified table space or index with the version information from the system pages of the object. Use REPAIR VERSIONS in the following situations:

- When you run the DSN1COPY utility with the OBIDXLAT option to move objects from one system to another. .
- Run REPAIR VERSIONS only when moving objects.

CATALOG

Indicates that REPAIR is to validate information in the catalog for the specified object.

REPAIR CATALOG is intended primarily for checking and correcting inconsistencies between the catalog and a table space after DSN1COPY is used to create a copy of a table space on a different subsystem from the subsystem on which the original table space resides.

When you specify REPAIR CATALOG, the utility performs the following actions:

- Compares the following information in the catalog with the data:

  For the following items, if the information in the catalog is different from the data, REPAIR changes the values in the catalog to match the data:

  - Row format (Row format can be either reordered row format or basic row format.)
  - RBA format (RBA format can be either 6-byte format or 10-byte format.)
  - Data version information (This check is the same function that is performed when you specify REPAIR VERSIONS.)
  - Hash space value
- Validates the following information:

  For these items, if the information in the catalog is different from the data, REPAIR does not correct the information in the catalog. Instead, REPAIR fails and reports the mismatched information in a message. To correct the mismatched information, take the action that is documented for the message that you receive.

  - DBID, PSID, and OBID
  - Table space type
  - SEGSIZE
  - PAGESIZE
  - Table definition

REPAIR CATALOG does not check limit key values.

REPAIR CATALOG does not make any corrections for indexes. If you or REPAIR made corrections to the data or catalog as a result of running REPAIR CATALOG, rebuild any indexes on the target tables.

You cannot specify CATALOG for LOB or XML table spaces.

TEST

Indicates that REPAIR is not to correct any mismatched information. The utility checks all of the same information that it checks when you specify REPAIR CATALOG. However, any information differences between the data and catalog are only reported in messages. The utility does not take any corrective actions.

CLONE

Indicates that REPAIR is to process only the specified objects that are table spaces that contain clone tables, indexes on clone tables, or index spaces that contain indexes on clone tables. If you specify CLONE, you cannot specify VERSIONS. Clones cannot be created for tables with active versions.

If you specify SET with CLONE, the status is changed for only the specified table spaces and their indexes. The CLONE keyword applies to all SET statements and LOCATE statements within the same REPAIR utility control statement.

SET statement syntax

The SET TABLESPACE statement resets the COPY-pending, RECOVER-pending, CHECK-pending, auxiliary warning (AUXW), auxiliary CHECK-pending (ACHKP), and advisory REORG-pending (AREO* and AREOR) statuses for a table space or data set. The SET TABLESPACE statement also turns on and off Persistent Read Only (PRO) restricted status for a table space partition. The SET INDEX statement resets the informational COPY-pending (ICOPY), RECOVER-pending, REBUILD-pending, CHECK-pending , and advisory REORG-pending (AREO* and AREOR) statuses for an index.

If you do not specify a status to reset, REPAIR takes no action.

set statement:

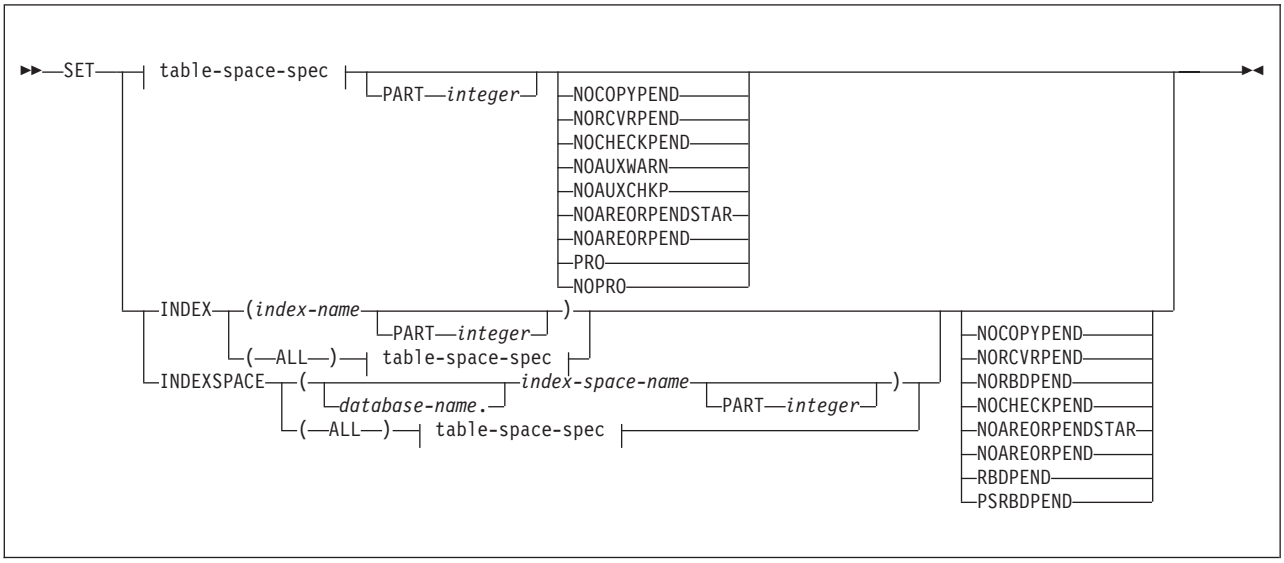
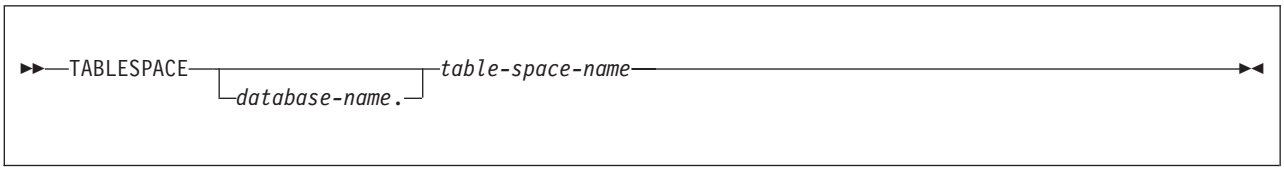


table-space-spec:



SET statement option descriptions

SET TABLESPACE *database-name.table-space-name*
Specifies the table space (and, optionally, the database to which it belongs) whose pending status is to be reset.

database-name
Specifies the name of the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name
Specifies the name of the table space.

SET INDEX
Specifies the index whose RECOVER-pending, CHECK-pending, REBUILD-pending, or informational COPY-pending status is to be reset.

(*index-name***)**
Specifies the index that is to be processed. Enclose the index name in quotation marks if the name contains a blank.

(ALL)
Specifies that all indexes in the table space will be processed.

You can also repair all indexes by specifying INDEX(ALL) followed by a *table-space-spec*.

SET INDEXSPACE
Specifies the index space for the index whose RECOVER-pending, CHECK-pending, REBUILD-pending, or informational COPY-pending status is to be reset.

(*database-name.index-space-name***)**
Specifies the index space that is to be processed.

(ALL)
Specifies that all indexes in the table space will be processed.

PART *integer*
Specifies a particular partition whose COPY-pending, or RECOVER-pending status is to be reset. If you do not specify PART, REPAIR resets the pending status of the entire table space or index.

integer is the number of the partition and must be in the range from one to the number of partitions that are defined for the

You can specify PART for NOCHECKPEND on a table space, and for NORCVRPEND on indexes.

The PART keyword is not valid for a LOB table space or an index on the auxiliary table.

The PART keyword is not valid when NOAREORPEND is specified because the AREOR state can only be reset for the entire table space or index space.

NOCOPYPEND
Specifies that the COPY-pending status of the specified table space, or the informational COPY-pending (ICOPY) status of the specified index is to be reset.

NORCVRPEND
Specifies that the RECOVER-pending (RECP) status of the specified table space or index is to be reset.

NORBDPEND
Specifies that the REBUILD-pending (RBDP) status, the page set REBUILD-pending status (PSRBDP), or the RBDP* status of the specified index is to be reset.

NOCHECKPEND
Specifies that the CHECK-pending (CHKP) status of the specified table space or index is to be reset.

NOAUXWARN
Specifies that the auxiliary warning (AUXW) status of the specified table space is to be reset. The specified table space must be a base table space or a LOB table space.

NOAUXCHKP
Specifies that the auxiliary CHECK-pending (ACHKP) status of the specified table space is to be reset. The specified table space must be a base table space.

NOAREORPENDSTAR
Resets the advisory REORG-pending (AREO*) status of the specified table space or index.

NOAREORPEND
Resets the advisory REORG-pending (AREOR) status of the specified table space or index.

PRO
Turns on Persistent Read Only (PRO) restricted status for a table space partition. The PART keyword is required for this option.

NOPRO
Turns off Persistent Read Only (PRO) restricted status for a table space partition. The PART keyword is required for this option.

RBDPEND
Specifies that the REBUILD-pending (RBDP) status is to be set on the specified index.

PSRBDPEND
Specifies that the PAGE SET REBUILD-pending (PSRBDP) status is to be set on the specified index.

LOCATE block syntax

A LOCATE block is a set of statements, each with its own options, that begins with a LOCATE statement and ends with the next LOCATE or SET statement, or with the end of the job. You can include more than one LOCATE block in a REPAIR utility statement.

In any LOCATE block, you can use VERIFY, REPLACE, or DUMP as often as you like; you can use DELETE only once.

locate block:

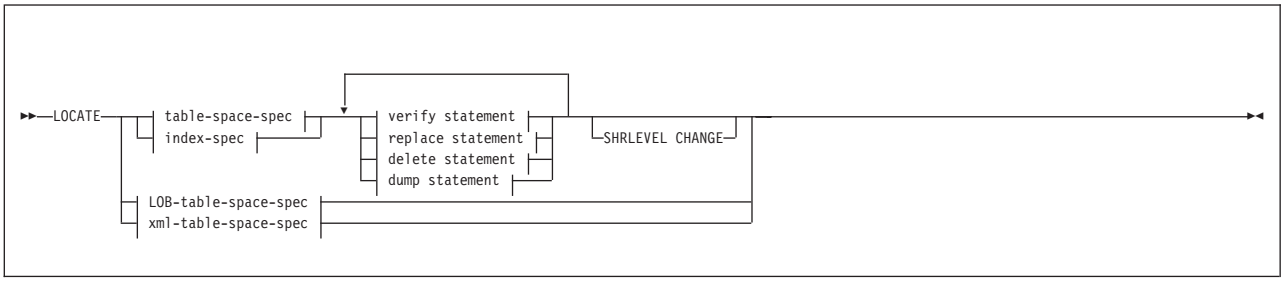
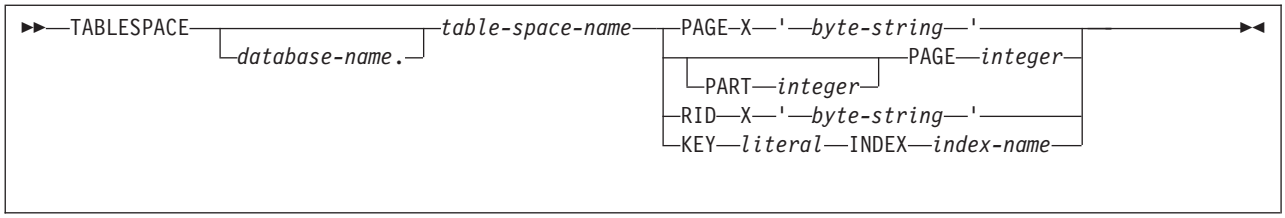
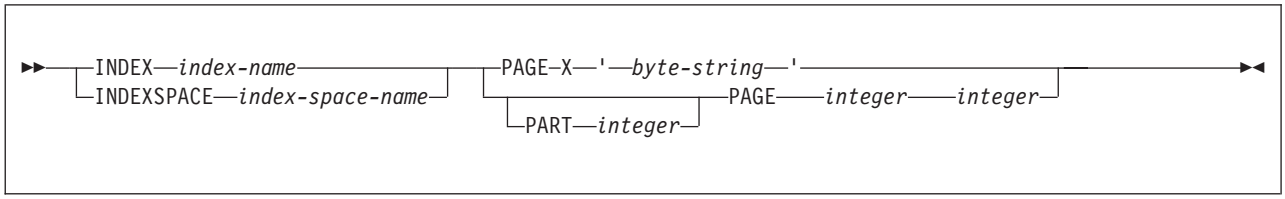


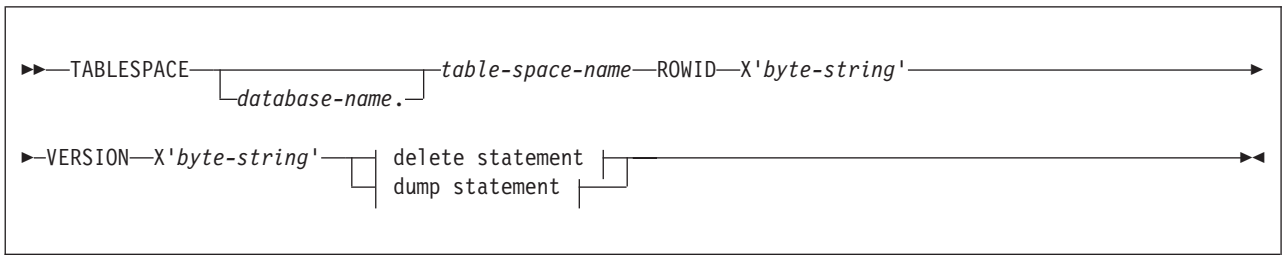
table-space-spec:



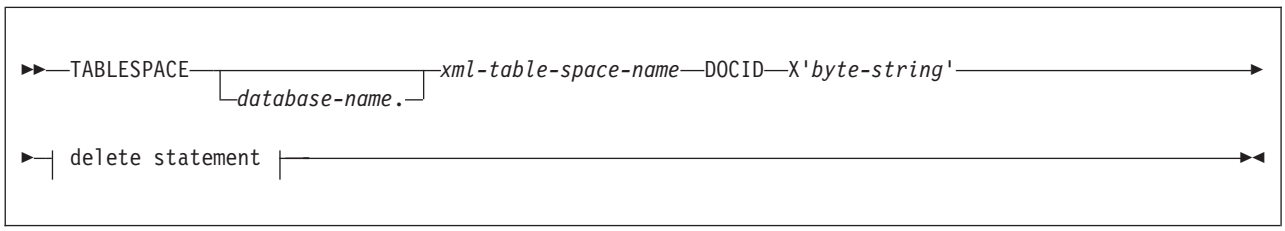
index-spec:



LOB-table-space-spec:



xml-table-space-spec:



LOCATE TABLESPACE statement option descriptions

The LOCATE TABLESPACE statement locates data that is to be repaired within a table space.

One LOCATE statement is required for each unit of data that is to be repaired. Several LOCATE statements can appear after each REPAIR statement.

If a REPAIR statement is followed by more than one LOCATE statement, all processing that is caused by VERIFY, REPLACE, and DUMP statements is committed before the next LOCATE statement is processed.

TABLESPACE
Specifies the base table space or XML table space (and, optionally, the database to which it belongs) in which data is to be located for repair.

database-name
The name of the database to which the base table space or XML table space belongs. This is optional.

table-space-name
The name of the base table space that contains the data to be repaired.

xml-table-space-name
The name of the XML table space that contains the data to be repaired.

PAGE
Specifies the relative page number within the table space, partitioned table space, or index that is to be operated on. The first page, in either case, is 0 (zero).

integer
integer is a decimal number from one to six digits in length.

X'*byte-string***'**
Specifies that the data of interest is an entire page. The specified offsets in *byte-string* and in subsequent statements are relative to the beginning of the page. The first byte of the page is at offset 0.

byte-string is a hexadecimal value from one to eight characters in length. You do not need to enter leading zeros. Enclose the *byte-string* between apostrophes, and precede it with X.

PART *integer*
Specifies the partition that contains the page that is to be located. Part is valid only for partitioned table spaces.

integer is the number of the partition.

RID X'*byte-string***'**
Specifies that the data that is to be located is a single row. The specified offsets in *byte-string* and in subsequent statements are relative to the beginning of the row. The first byte of the stored row prefix is at offset 0.

byte-string can be a hexadecimal value from one to eight characters in length. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with an X.

KEY *literal*
Specifies that the data that is to be located is a single row, identified by *literal*. The specified offsets in subsequent statements are relative to the beginning of the row. The first byte of the stored row prefix is at offset 0.

literal is any SQL constant that can be compared with the key values of the named index.

Character constants that are specified within the LOCATE KEY option cannot be specified as ASCII or Unicode character strings. No conversion of the values is performed. To use this option when the table space is ASCII or Unicode, you should specify the values as hexadecimal constants.

If more than one row has the value *literal* in the key column, REPAIR returns a list of record identifiers (RIDs) for records with that key value, but does **not** perform any other operations (verify, replace, delete, or dump) until the next LOCATE TABLESPACE statement is encountered. To repair the proper data, write a LOCATE TABLESPACE statement that selects the row that you want, using the RID option, the PAGE option, or a different KEY and INDEX option. Then, execute REPAIR again.

SHRLEVEL
Indicates the type of access that is to be allowed for the index, table space, or partition that is to be repaired during REPAIR processing.

If you do not specify SHRLEVEL and you do specify DUMP or VERIFY, applications can read but not write the area.

If you do not specify SHRLEVEL and you do specify DELETE or REPLACE, applications cannot read or write the area.

CHANGE
Specifies that applications can read and write during the VERIFY, REPLACE, DELETE, and DUMP operation.

ROWID X'*byte-string***'**
Specifies that the data that is to be located is a LOB in a LOB table space.

byte-string is the row ID that identifies the LOB column.

Use the ROWID keyword to repair an orphaned LOB row. You can find the ROWID in the output from the CHECK LOB utility. If you specify the ROWID keyword, the specified table space must be a LOB table space.

VERSION X'*byte-string***'**
Specifies that the data that is to be located is a LOB in a LOB table space.

byte-string is the version number that identifies the version of the LOB column.

Use the VERSION keyword to repair an orphaned LOB column. You can find the VERSION number in the output of the CHECK LOB utility or an out-of-synch LOB that is reported by the CHECK DATA utility. If you specify the VERSION keyword, the specified table space must be a LOB table space.

LOCATE INDEX statement and LOCATE INDEXSPACE statement option descriptions

The LOCATE INDEX (or INDEXSPACE) statement locates data that is to be repaired within an index. You can specify indexes by either their index name or their index space name.

One LOCATE statement is required for each unit of data that is to be repaired. Multiple LOCATE statements can appear after each REPAIR statement.

If a REPAIR statement is followed by multiple LOCATE statements, all processing that is caused by VERIFY, REPLACE, and DUMP statements is committed before the next LOCATE statement is processed.

INDEX *index-name*
Specifies a particular index that is to be used to find the row that contains the key. When you are locating an index by key, the index that you specify must be a single-column index.

index-name is the qualified or unqualified name of the index. If you omit the qualifier creator ID, the user identifier for the utility job is used. Enclose the index name in quotation marks if the name contains a blank.

INDEXSPACE *index-space-name*
Specifies the index space for a particular index that is to be used to find the row that contains the key. Look in the SYSIBM.SYSINDEXES catalog table to find the index space name for an index. When you are locating an index by key, the index that you specify must be a single-column index.

index-space-name is the qualified name of the index space, in the form *database-name.index-space-name*.

PAGE *integer*
Specifies the relative page number within the index space that is to be operated on. The first page is 0 (zero).

integer
integer is a decimal number from one to six digits in length.

X'*byte-string***'**
Specifies that the data of interest is an entire page. The specified offsets in *byte-string* and in subsequent statements are relative to the beginning of the page. The first byte of the page is at offset 0.

byte-string is a hexadecimal value from one to eight characters in length. You do not need to enter leading zeros. Enclose the *byte-string* between apostrophes, and precede it with X.

PART *integer*
Specifies the partition number of the partitioning index that contains the page that is to be located. The PART keyword is valid only for indexes of partitioned table spaces.

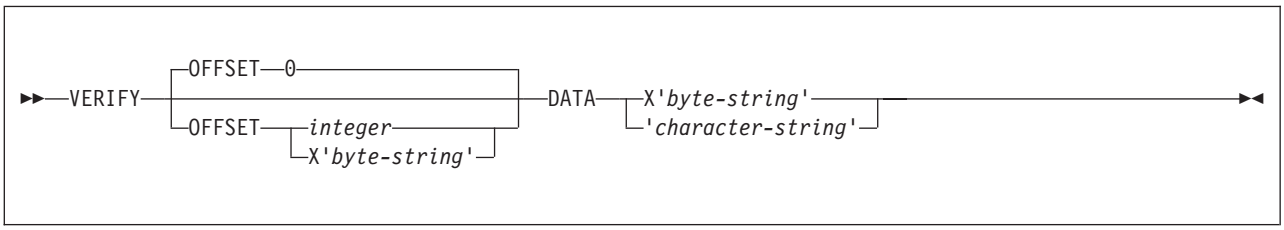
integer is the number of the partitioning index.

VERIFY statement syntax

The VERIFY statement tests whether a particular data area contains a specified value. Depending on the outcome of this test, the REPAIR utility performs the following actions:

- If the data area does contain the value, subsequent operations in the same LOCATE block are allowed to proceed.
- If **any** data area does not contain its specified value, **all** subsequent operations in the same LOCATE block are inhibited.

verify statement:



VERIFY statement option descriptions

OFFSET
Locates the data that is to be tested by a relative byte address (RBA) within the row or page.

integer
Identifies the offset as an integer.

The default value is **0**, the first byte of the area that is identified by the previous LOCATE statement.

X'*byte-string***'**
Identifies the offset as one to four hexadecimal characters. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

DATA
Specifies what data must be present at the current location before a change is made.

Character constants that are specified within the VERIFY DATA option cannot be specified as ASCII or Unicode character strings. No conversion of the values is performed. To use this option when the table space is ASCII or Unicode, you should specify the values as hexadecimal constants.

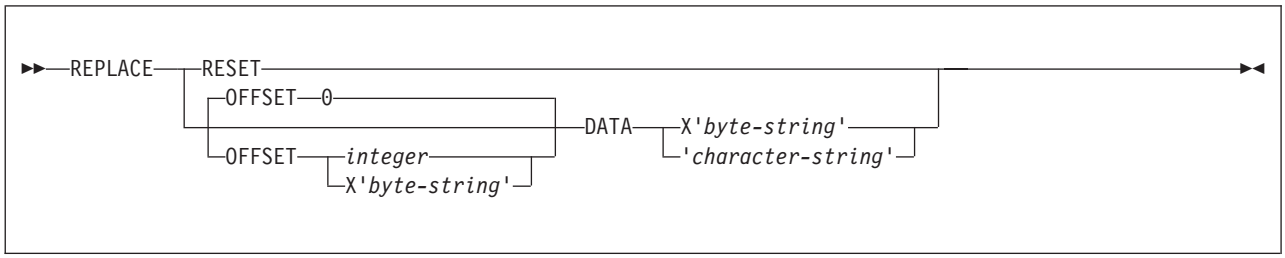
X'*byte-string***'**
Specifies an even number, from 2 to 32, of hexadecimal characters that must be present. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

'*character-string***'**
Specifies any character string that must be present.

REPLACE statement syntax

The REPLACE statement replaces data at a particular location. The statement is contained within a LOCATE block. If any VERIFY statement within that block finds a data area that does not contain its specified data, the REPLACE operation is inhibited.

replace statement:



REPLACE statement option descriptions

RESET
Specifies that the inconsistent data indicator is to be reset. A page for which this indicator is on is considered in error, and the indicator must be reset before you can access the page. Numbers of pages with inconsistent data are reported at the time that they are encountered.

The option also resets the PGCOMB flag bit in the first byte of the page to agree with the bit code in the last byte of the page.

OFFSET
Indicates where data is to be replaced by a relative byte address (RBA) within the row or page. Only one OFFSET and one DATA specification are acted on for each REPLACE statement.

integer
Specifies the offset as an integer.

The default value is **0**, the first byte of the area that is identified by the previous LOCATE statement.

X'*byte-string***'**
Specifies the offset as one to four hexadecimal characters. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

DATA
Specifies the new data that is to be entered. Only one OFFSET and one DATA specification are acted on for each REPLACE statement.

Important: Do not run REPAIR with the REPLACE, OFFSET, and DATA options on a compressed table space.

Character constants that are specified within the VERIFY DATA option cannot be specified as ASCII or Unicode character strings. The values are not converted. To use this option when the table space is ASCII or Unicode, specify the values as hexadecimal constants.

X'*byte-string***'**
Specifies an even number, from 2 to 32, of hexadecimal characters that are to replace the current data. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

'*character-string***'**
Specifies any character string that is to replace the current data.

DELETE statement syntax

The DELETE statement deletes a single row of data that has been located by a RID or KEY option. The statement is contained within a LOCATE block. If any VERIFY statement within that block finds a data area that does not contain its specified data, the DELETE operation is inhibited.

The DELETE statement operates without regard for referential constraints. If you delete a parent row, its dependent rows remain unchanged in the table space.

In any LOCATE block, you can include no more than one DELETE option.

If you have coded any of the following options, you cannot use DELETE:
- The LOG NO option on the REPAIR statement
- A LOCATE INDEX statement to begin the LOCATE block
- The PAGE option on the LOCATE TABLESPACE statement in the same LOCATE block
- A REPLACE statement for the same row of data

When you specify LOCATE ROWID for a LOB table space, the LOB that is specified by ROWID is deleted with its index entry. All pages that are occupied by the LOB are converted to free space. The DELETE statement **does not** remove any reference to the deleted LOB from the base table space.

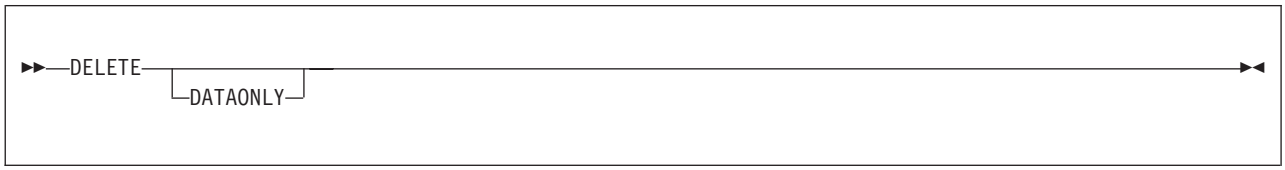
When you specify LOCATE DOCID for an XML table space, the XML document that is specified by DOCID is deleted with its NodeID index entries. All rows that are occupied by the XML document are deleted from the XML table space. The DELETE statement does not remove any reference to the deleted XML document

from the base table space. The LOCATE DOCID statement is generated by CHECK DATA SHRLEVEL CHANGE in order to remove corrupted XML documents from the XML table space.

REPAIR DELETE can delete the following data rows when the specified conditions exists:

- A compressed row without an index defined on the table
- A compressed row with an index defined on the table and a valid dictionary exists to decompress the row
- A compressed or uncompressed data row that is missing an index entry
- A compressed row with an index defined on the table, but the dictionary is invalid
- An uncompressed row without an index
- An uncompressed row with valid Index

delete statement:



DELETE statement option descriptions

DATAONLY
Specifies that REPAIR should delete only the data record that is specified by the LOCATE RID statement. Any associated indexes, LOB columns, XML columns, or referential integrity constraints are not deleted.

You can specify the DATAONLY option only when REPAIR locates a single row by using a RID.

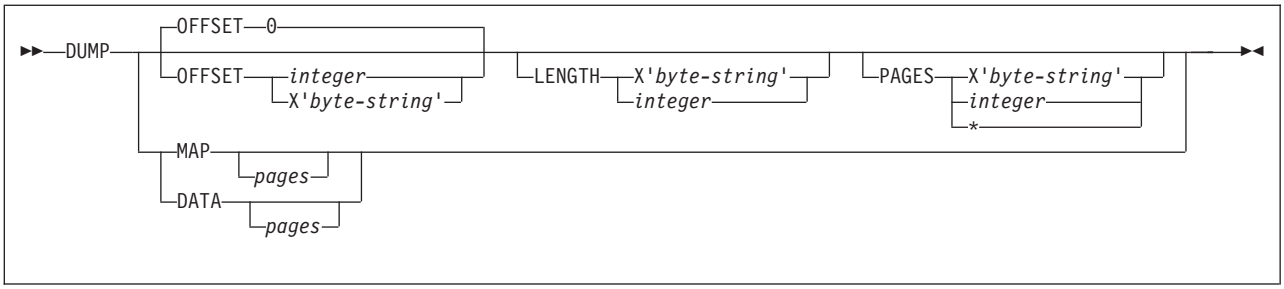
If the table has indexes or LOB or XML columns, ensure that after you run the DELETE DATAONLY statement, the data is consistent with the other associated objects.

DUMP statement syntax

The DUMP statement produces a hexadecimal dump of data that is identified by offset and length. DUMP statements have no effect on VERIFY or REPLACE operations.

When you specify LOCATE ROWID for a LOB table space, one or more map or data pages of the LOB are dumped. The DUMP statement dumps all of the LOB column pages if you do not specify either the MAP or DATA keyword.

dump statement:



DUMP statement option descriptions

OFFSET
Optionally, locates the data that is to be dumped by a relative byte address (RBA) within the row or page.

integer
Specifies the offset as an integer.

The default value is **0**, the first byte of the row or page.

X'*byte-string***'**
Specifies the offset as one to four hexadecimal characters. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

LENGTH
Optionally, specifies the number of bytes of data that are to be dumped. If you omit both LENGTH and PAGE, the dump begins at the specified OFFSET and continues to the end of the row or page.

If you specify a number of bytes (with LENGTH) and a number of pages (with PAGE), the dump contains the same relative bytes from each page. That is, from each page you see the same number of bytes, beginning at the same offset.

X'*byte-string***'**
Specifies one to four hexadecimal characters. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

integer
Specifies the length as an integer.

PAGES
Optionally, specifies a number of pages that are to be dumped. You can use this option only if you used PAGE in the preceding LOCATE TABLESPACE control statement.

X'*byte-string***'**
Specifies one to four hexadecimal characters. You do not need to enter leading zeros. Enclose the byte string between apostrophes, and precede it with X.

integer
Specifies the number of pages as an integer.

***** Specifies that all pages from the starting point to the end of the table space or partition are to be dumped.

MAP *pages*
Specifies that only the LOB map pages are to be dumped.

pages specifies the number of LOB map pages that are to be dumped. If you do not specify *pages*, all LOB map pages of the LOB that is specified by ROWID and version are dumped.

DATA *pages*
Specifies that only the LOB data pages are to be dumped.

pages specifies the number of LOB data pages that are to be dumped. If you do not specify *pages*, all LOB data pages of the LOB that is specified by ROWID and version are dumped.

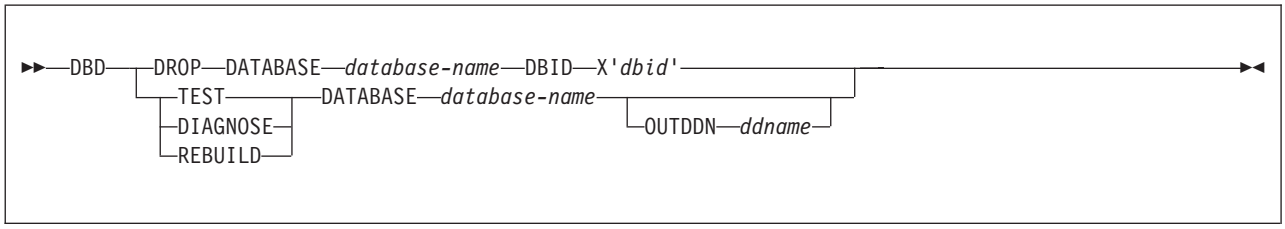
DBD statement syntax

Use the DBD statement to perform one or more of the following actions:

- Compare the database definition (DBD) in the DB2 catalog with its definition in the DB2 directory
- Rebuild a database definition in the directory by using the information, including LOB information, in the DB2 catalog
- Drop an inconsistent database definition from the DB2 catalog and the DB2 directory

For more information about how to use the DBD statement to perform these actions, see "Repairing DBDs" on page 686.

dbd statement:



DBD statement option descriptions

DROP
Specifies that the named database is to be dropped from both the DB2 catalog and the DB2 directory. When you specify this option, DB2 also drops databases that contain tables that have been created with RESTRICT ON DROP. Use this keyword if the SQL DROP DATABASE statement fails because the description of the database is not in both the DB2 catalog and the DB2 directory. If you cannot use the ALTER command to remove the with RESTRICT ON DROP option on tables in a database that is badly damaged and you need to drop the database, you can use this keyword to drop the database.

Attention: Use the DROP option with extreme care. Using DROP can cause additional damage to your data. For more assistance, you can contact IBM Software Support.

DATABASE *database-name*
Specifies the target database.

database-name is the name of the target database, which cannot be DSNDB01 (the DB2 directory) or DSNDB06 (the DB2 catalog).

If you use TEST, DIAGNOSE, or REBUILD, *database-name* cannot be DSNDB07 (the work file database).

If you use DROP, *database-name* cannot be DSNDB04 (the default database).

DBID X'*dbid***'**
Specifies the database descriptor identifier for the target database.

dbid is the database descriptor identifier.

TEST
Specifies that a DBD is to be built from information in the DB2 catalog, and is to be compared with the DBD in the DB2 directory. If you specify TEST, DB2 reports significant differences between the two DBDs.

If the condition code is 0, the DBD in the DB2 directory is consistent with the information in the DB2 catalog.

If the condition code is not 0, then the information in the DB2 catalog and the DBD in the DB2 directory might be inconsistent. Run REPAIR DBD with the DIAGNOSE option to gather information that is necessary for resolving any possible inconsistency.

DIAGNOSE
Specifies that information that is necessary for resolving an inconsistent database definition is to be generated. Like the TEST option, DIAGNOSE builds a DBD that is based on the information in the DB2 catalog and compares it with the DBD in the DB2 directory. In addition, DB2 reports any differences between the two DBDs, and produces hexadecimal dumps of the inconsistent DBDs.

If the condition code is 0, the information in the DB2 catalog and the DBD in the DB2 directory is consistent.

If the condition code is 8, the information in the DB2 catalog and the DBD in the DB2 directory might be inconsistent.

For further assistance in resolving any inconsistencies, you can contact IBM Software Support.

REBUILD
Specifies that the DBD that is associated with the specified database is to be rebuilt from the information in the DB2 catalog.

Attention: Use the REBUILD option with extreme care, as you can cause more damage to your data. For more assistance, you can contact IBM Software Support.

OUTDDN *ddname*
Specifies the DD statement for an optional output data set. This data set contains copies of the DB2 catalog records that are used to rebuild the DBD.

ddname is the name of the DD statement.

Related tasks:

"Copying tables from one subsystem to another" on page 972

Before running REPAIR

Certain activities might be required before you run the REPAIR utility, depending on your situation.

Attention: Be extremely careful when using the REPAIR utility to replace data. Changing data to invalid values by using REPLACE might produce unpredictable results, particularly when changing page header information. Improper use of REPAIR can result in damaged data, or in some cases, system failure.

Making a copy of the table space

Before starting to use REPAIR to change data, ensure that you have a copy (full image copy or DSN1COPY generated copy) of the affected table space to enable fallback.

Restoring damaged indexes

Because REPAIR can access index data only by referring to a page and an offset within the page, identifying and correcting a problem can be difficult. Use REBUILD INDEX or RECOVER INDEX to restore damaged index data.

Running REPAIR on encrypted data

Do not run REPAIR on encrypted data. REPAIR does not decrypt the data. The utility reads the data in its encrypted form and then manipulates the data without decrypting it.

Data sets that REPAIR uses

The REPAIR utility uses a number of data sets during its operation.

The following table lists the data sets that REPAIR uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 101. Data sets that REPAIR uses

Data set	Data set	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
Optional output data set	Data set that contains copies of the DB2 catalog records that are used to rebuild the DBD. You define the DD name.	No

The following objects are named in the utility control statement and do not require a DD statement in the JCL:

Table space or index
Object that is to be repaired.

Calculating output data set size

Use the following formula to estimate the size of the output data set:

```
SPACE = (4096,(n,n))
```

In this formula, *n* = the total number of DB2 catalog records that relate to the database on which REPAIR DBD is being executed.

You can calculate an estimate for *n* by summing the results of SELECT COUNT(*) from the following catalog tables, for catalog table rows whose database name matches the name of the database on which REPAIR DBD is being executed.

- SYSCOLAUTH
- SYSCOLUMNS
- SYSFIELDS
- SYSFOREIGNKEYS
- SYSINDEXES
- SYSINDEXPART
- SYSKEYS
- SYSRELS
- SYSSYNONYMS
- SYSTABAUTH
- SYSTABLEPART
- SYSTABLES
- SYSTABLESPACE

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for REPAIR

The REPAIR utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities that operate on different partitions of the same table space or index space are compatible.

Claims

The following table shows which claim classes REPAIR drains and any restrictive state that the utility sets on the target object.

Table 102. Claim classes of REPAIR operations

Action	Table space or partition	Index or partition
REPAIR LOCATE KEY DUMP or VERIFY	DW/UTRO	DW/UTRO
REPAIR LOCATE KEY DELETE or REPLACE	DA/UTUT	DA/UTUT
REPAIR LOCATE RID DUMP or VERIFY	DW/UTRO	None
REPAIR LOCATE RID DELETE	DA/UTUT	DA/UTUT
REPAIR LOCATE RID REPLACE	DA/UTUT	None
REPAIR LOCATE TABLESPACE DUMP or VERIFY	DW/UTRO	None
REPAIR LOCATE TABLESPACE REPLACE	DA/UTUT	None

Table 102. Claim classes of REPAIR operations (continued)

Action	Table space or partition	Index or partition
REPAIR LOCATE INDEX PAGE DUMP or VERIFY	None	DW/UTRO
REPAIR LOCATE INDEX PAGE DELETE	None	DA/UTUT

Legend:
- DA - Drain all claim classes - no concurrent SQL access.
- DW - Drain the write claim class - concurrent access for SQL readers.
- UTUT - Utility restrictive state - exclusive control.
- UTRO - Utility restrictive state - read-only access allowed.
- None - Object is not affected by this utility.

REPAIR does not set a utility restrictive state if the target object is DSNDB01.SYSUTILX.

Compatibility

The following tables show which utilities can run concurrently with REPAIR on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also shown in the table.

The following table shows which utilities can run concurrently with REPAIR LOCATE by KEY or RID.

Table 103. Utility compatibility with REPAIR, LOCATE by KEY or RID

Utility	DUMP or VERIFY	DELETE or REPLACE
CHECK DATA	No	No
CHECK INDEX	Yes	No
CHECK LOB	Yes	No
COPY INDEXSPACE	Yes	No
COPY TABLESPACE	Yes	No
DIAGNOSE	Yes	Yes
LOAD	No	No
MERGECOPY	Yes	Yes
MODIFY	Yes	Yes
QUIESCE	Yes	No
REBUILD INDEX	No	No
RECOVER INDEX [1]	No	No
RECOVER TABLESPACE	No	No
REORG INDEX [2]	No	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes	No
REPAIR DELETE or REPLACE [3]	No	No
REPAIR DUMP or VERIFY	Yes	No

Table 103. Utility compatibility with REPAIR, LOCATE by KEY or RID (continued)

Utility	DUMP or VERIFY	DELETE or REPLACE
REPORT	Yes	Yes
RUNSTATS INDEX SHRLEVEL CHANGE	Yes	Yes
RUNSTATS INDEX SHRLEVEL REFERENCE	Yes	No
RUNSTATS TABLESPACE	Yes	No
STOSPACE	Yes	Yes
UNLOAD	Yes	No

Notes:

1. REORG INDEX is compatible with LOCATE by RID, DUMP, VERIFY, or REPLACE.
2. RECOVER INDEX is compatible with LOCATE by RID, DUMP, or VERIFY.
3. REPAIR LOCATE INDEX PAGE REPLACE is compatible with LOCATE by RID or REPLACE.

The following table shows which utilities can run concurrently with REPAIR LOCATE by PAGE.

Table 104. Utility compatibility with REPAIR, LOCATE by PAGE

Utility or action	TABLESPACE DUMP or VERIFY	TABLESPACE REPLACE	INDEX DUMP or VERIFY	INDEX REPLACE
SQL read	Yes	No	Yes	No
SQL write	No	No	No	No
CHECK DATA	No	No	No	No
CHECK INDEX	Yes	No	Yes	No
CHECK LOB	Yes	No	Yes	No
COPY INDEXSPACE	Yes	Yes	Yes	No
COPY TABLESPACE	Yes	No	Yes	No
DIAGNOSE	Yes	Yes	Yes	Yes
LOAD	No	No	No	No
MERGECOPY	Yes	Yes	Yes	Yes
MODIFY	Yes	Yes	Yes	Yes
QUIESCE	Yes	No	Yes	No
REBUILD INDEX	Yes	No	No	N/A
RECOVER INDEX	Yes	No	No	No
RECOVER TABLESPACE (with no option)	No	No	Yes	Yes
RECOVER TABLESPACE ERROR RANGE	No	No	Yes	Yes
RECOVER TABLESPACE TOCOPY or TORBA	No	No	No	No
REORG INDEX	Yes	Yes	No	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No	No	No

Table 104. Utility compatibility with REPAIR, LOCATE by PAGE (continued)

Utility or action	TABLESPACE DUMP or VERIFY	TABLESPACE REPLACE	INDEX DUMP or VERIFY	INDEX REPLACE
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes	No	Yes	Yes
REPAIR DELETE or REPLACE	No	No	No	No
REPAIR DUMP or VERIFY[1]	Yes	No	Yes	No
REPORT	Yes	Yes	Yes	Yes
RUNSTATS INDEX	Yes	Yes	Yes	No
RUNSTATS TABLESPACE	Yes	No	Yes	Yes
STOSPACE	Yes	Yes	Yes	Yes
UNLOAD	Yes	No	Yes	Yes

Note:

1. REPAIR LOCATE INDEX PAGE REPLACE is compatible with LOCATE TABLESPACE PAGE.

Resetting table space status

In most cases, resetting the COPY-pending restriction by taking a full image copy is preferable to using REPAIR. This is because RECOVER cannot be executed successfully until an image copy has been made.

Resetting the RECOVER-pending status by running RECOVER or LOAD is preferable to using REPAIR. This is because RECOVER uses DB2-controlled recovery information, whereas REPAIR SET TABLESPACE or INDEX resets the RECOVER-pending status without considering the recoverability of the table space. Recoverability issues include the availability of image copies, of rows in SYSIBM.SYSCOPY, and of log data sets.

Verifying and possibly correcting referential integrity constraints by running CHECK DATA are recommended. CHECK DATA performs a complete check of all referential integrity constraints of the table space set, whereas with REPAIR, you are responsible for checking all the referential integrity constraints violations.

To reset the CHECK-pending status for a LOB table space:

1. Run the CHECK DATA utility again with the AUXERROR INVALIDATE keywords specified.
2. Update the invalid LOBs.

To reset the auxiliary warning (AUXW) status for a LOB table space:

1. Update or correct the invalid LOB columns, then
2. Run the CHECK LOB utility with the AUXERROR INVALIDATE option if invalid LOB columns were corrected.

Resetting index space status

Running COPY INDEXSPACE to reset the informational COPY-pending status is preferable to using the REPAIR utility to reset the status.

Consider using the REBUILD INDEX or RECOVER INDEX utility on an index that is in REBUILD-pending status, rather than running REPAIR SET INDEX NORBDPEND. RECOVER uses DB2-controlled recovery information, whereas REPAIR SET INDEX resets the REBUILD-pending status without considering the recoverability of the index. Recoverability issues include the availability of image copies, of rows in SYSIBM.SYSCOPY, and of log data sets.

Repairing a damaged page

You can use the REPAIR utility to repair a damaged page.

Procedure

To repair a damaged page:

1. Execute REPAIR with the LOG YES option and the DUMP control statement, specifying the pages that you suspect are damaged. Then, verify that the dump you received contains the pages that you want.
2. If you know which page is damaged and you can see how to resolve the error, repair the page and reset the "inconsistent data" indicator. Run REPAIR with the REPLACE RESET DATA control statement. Document your actions in case you need to undo anything later.
3. If you determine that the page is not really damaged, but merely has the "inconsistent data" indicator on, reset the indicator by running REPAIR with the REPLACE RESET control statement.

Repairing DBDs

You can check and repair database definitions (DBDs) in the catalog and directory by using the REPAIR utility with the DBD statement.

About this task

You can use REPAIR DBD on declared temporary tables, which must be created in a database that is defined with the AS TEMP clause. No other DB2 utilities can be used on a declared temporary table, its indexes, or its table spaces.

Procedure

To repair DBDs:

1. Run REPAIR DBD with the TEST option to determine whether the information in the DB2 catalog is consistent with the DBD in the DB2 directory.

   REPAIR DBD TEST obtains environment information, such as the character that is used for the decimal point, from the application defaults load module that is used by the subsystem. The application defaults load module is either the default load module DSNHDECP or a user-specified application defaults load module. If the return code is not 0, inconsistencies exist.
2. If inconsistencies exist, run REPAIR DBD with the DIAGNOSE and OUTDDN options to produce diagnostic information.

   REPAIR DBD DIAGNOSE obtains environment information, such as the character that is used for the decimal point, from the application defaults load module that is used by the subsystem.

   Contact IBM Software Support for assistance in analyzing this information.
3. If IBM Software Support instructs you to do so, replace the existing DBD by running REPAIR DBD with the REBUILD option.

Attention: Do not use the REBUILD option if you suspect that information in the catalog is causing the inconsistency. REBUILD uses information in the catalog to rebuild the DBD; if the catalog is incorrect, the rebuilt DBD cannot be correct.

REPAIR DBD REBUILD obtains environment information, such as the character that is used for the decimal point, from the DSNHDECP module for the subsystem.

DB2 starts the database for access by utilities only. After successful completion of the REPAIR utility, the database continues to be started for utility access only.

When REPAIR DBD REBUILD is running, an S-lock is acquired for the appropriate catalog tables. If the S-lock fails, REPAIR DBD fails.

DB2 reads each table space in the database during the REBUILD process to gather information. If the data sets for the table spaces do not exist or are not accessible to DB2, the utility abnormally terminates.

4. If you suspect an inconsistency in the DBD of the work file database, consider issuing the DROP DATABASE SQL statement or running REPAIR DBD DROP. Then re-create the database.

   Attention: Use REPAIR DBD DROP with extreme care. Using DROP can cause additional damage to your data. For more assistance, contact IBM Software Support.

   If you receive errors when you drop the work file database, contact IBM Software Support for assistance.

5. If you ran REPAIR DBD REBUILD, the database is started for utility-only access, and you must restart the database for read/write access manually by performing the following steps:
   a. Issue the STOP DATABASE (*database-name*) command.
   b. Issue the START DATABASE (*database-name*) ACCESS(RW) command to allow full access to the database.

6. Rebind any trigger packages that were invalidated.

   When you run REPAIR DBD REBUILD on a database, DB2 invalidates packages for any triggers that are defined on tables in that database. To find those triggers, use the following query:

   ```
   SELECT T.NAME, T.SCHEMA FROM
   SYSIBM.SYSTRIGGERS T,SYSIBM.SYSDATABASE D
   WHERE T.DBID= D.DBID AND D.NAME = ' your database name here'
   ```

   After you run REPAIR DBD REBUILD, you must rebind those trigger packages. The DB2 release on which you rebind the trigger packages must be the same as the DB2 release on which you ran REPAIR DBD REBUILD.

Related reference:

"Syntax and options of the REPAIR control statement" on page 664

DROP (DB2 SQL)

-START DATABASE (DB2) (DB2 Commands)

-STOP DATABASE (DB2) (DB2 Commands)

Locating rows by key

If you use LOCATE TABLESPACE KEY, a number of rows might satisfy the condition. In this case, REPAIR returns only the RIDs of the rows and does not perform any VERIFY, REPLACE, DELETE, or DUMP actions which might be coded in that LOCATE block.

You can use the RID option of LOCATE TABLESPACE to identify a specific row. Examples of the messages that are issued are shown in the following example:

```
DSNU658I - DSNUCBRL - MULTIPLE RECORDS FOUND WITH SPECIFIED KEY
DSNU660I - DSNUCBRL - POSSIBLE RID - X00000100B'
DSNU660I - DSNUCBRL - POSSIBLE RID - X000000C18'
DSNU660I - DSNUCBRL - POSSIBLE RID - X000000916'
DSNU660I - DSNUCBRL - POSSIBLE RID - X000000513'
DSNU650I - DSNUCBRP - DUMP
DSNU012I   DSNUGBAC - UTILITY EXECUTION TERMINATED,
                      HIGHEST RETURN CODE=8
```

Multiple-column indexes

The KEY option supports only single-column indexes. The following message is issued if you try to locate a row by using a multiple-column index.

```
DSNUCBRK - INDEX USED HAS MULTIPLE-FIELD KEY
```

Using VERIFY with REPLACE and DELETE operations

If any data area does not contain the value that is required by a VERIFY statement, all REPLACE and DELETE operations in the same locate block are inhibited. VERIFY and REPLACE statements that follow the next LOCATE statement are not affected.

Repairing critical catalog table spaces and indexes

An ID with a granted authority receives message DSNT500I RESOURCE UNAVAILABLE, while trying to repair a table space or index in the catalog or directory if table space DSNDB06.SYSUSER is unavailable.

About this task

If you get this message, you must either make these table spaces available or run the REPAIR utility on the catalog or directory by using an authorization ID with the installation SYSADM or installation SYSOPR authority.

Related information:

DSNT500I (DB2 Messages)

Termination or restart of REPAIR

You can terminate the REPAIR utility, but you cannot restart the REPAIR utility.

You can terminate a REPAIR job with the **TERM UTILITY** command.

REPAIR cannot be restarted. If you attempt to restart REPAIR, you receive message DSNU181I, which states that the utility cannot be restarted. You must terminate the job with the **TERM UTILITY** command, and rerun REPAIR from the beginning.

Related reference:

-TERM UTILITY (DB2) (DB2 Commands)

Review of REPAIR output

The output from the REPAIR utility can consist of any modified pages in the specified DB2 table space or index. Alternatively, the REPAIR utility can produce a complete dump of the content of the table space.

Error messages

At each LOCATE statement, the last data page and the new page that are being located are checked for a few common errors, and messages are issued.

Data checks

Although REPAIR enables you to manipulate both user and DB2 data by bypassing SQL, it does perform some checking of data. For example, if REPAIR tries to write a page with the wrong page number, DB2 abnormally terminates with a 04E code and reason code C200B0. If the page is broken because the broken page bit is on or the incomplete page flag is set, REPAIR issues the following message:

```
DSNU670I + DSNUCBRP - PAGE X'000004' IS A BROKEN PAGE
```

After running REPAIR

Certain activities might be required after you run the REPAIR utility, depending on your situation.

CHECK-pending status

You are responsible for violations of referential constraints that are a result of running REPAIR. These violations cause the target table space to be placed in the CHECK-pending status.

After running REPAIR DBD REBUILD

Make sure that you rebind any invalidated trigger packages. See the information about repairing DBDs.

Related tasks:

"Repairing DBDs" on page 686

Related reference:

Chapter 12, "CHECK DATA," on page 79

Sample REPAIR control statements

Use the sample control statements as models for developing your own REPAIR control statements.

Example: Replacing damaged data and verifying replacement

The following control statement specifies that the REPAIR utility is to perform the following actions:

- Repair the specified page of table space DSN8D81A.DSN8S81D, as indicated by the LOCATE clause.
- Verify that, at the specified offset (50), the damaged data (0A00) is found, as indicated by the VERIFY clause.
- Replace the damaged data with the data that you want (0D11), as indicated by the REPLACE clause.
- Initiate® a dump beginning at offset 50, for 4 bytes, as indicated by the DUMP clause. You can use the generated dump to verify the replacement.

```
//STEP1    EXEC  DSNUPROC,UID='IUIQU1UH',UTPROC='',SYSTEM='DSN'
//SYSIN DD *
REPAIR OBJECT
```

```
  LOCATE TABLESPACE DSN8D11A.DSN8S11D PAGE X'02'
    VERIFY OFFSET 50 DATA X'0A00'
    REPLACE OFFSET 50 DATA X'0D11'
    DUMP OFFSET 50 LENGTH 4
```

Example: Removing a nonindexed row that is found by REORG

When reorganizing table space DSNDB04.TS1, assume that you received the following message:

```
DSNU3401 DSNURBXA - ERROR LOADING INDEX, DUPLICATE KEY
                    INDEX = EMPINDEX
                    TABLE = EMP
                    RID OF INDEXED ROW  = X'0000000201'
                    RID OF NONINDEXED ROW = X'0000000503'
```

To resolve this error condition, submit the following control statement, which specifies that REPAIR is to delete the nonindexed row and log the change. (The LOG keyword is not required; the change is logged by default.) The RID option identifies the row that REPAIR is to delete.

```
REPAIR
  LOCATE TABLESPACE DSNDB04.TS1 RID (X'0000000503')
    DELETE
```

Example: Reporting whether catalog and directory DBDs differ

The following control statement specifies that REPAIR is to compare the DBD for DSN8D2AP in the catalog with the DBD for DSN8D2AP in the directory.

```
REPAIR DBD TEST DATABASE DSN8D2AP
```

If the condition code is 0, the DBDs are consistent. If the condition code is not 0, the DBDs might be inconsistent. In this case, run REPAIR DBD with the DIAGNOSE option, as shown in example 4, to find out more detailed information about any inconsistencies.

Example: Reporting differences between catalog and directory DBDs

The following control statement specifies that the REPAIR utility is to report information about the inconsistencies between the catalog and directory DBDs for DSN8D2AP. Run this job after you run a REPAIR job with the TEST option (as shown in example 3), and the condition code is not 0. In this example, SYSREC is the output data set, as indicated by the OUTDDN option.

```
REPAIR DBD DIAGNOSE DATABASE DSN8D2AP OUTDDN SYSREC
```

Example: Resetting restrictive states

The control statement in this example specifies that the REPAIR utility is to reset the following restrictive states for the indicated objects:

- For all indexes on table spaces DBNI1601.TSNI1601 and DBNI1601.TSNI1602, reset RBDP, PSRBDP, or RBDP* status.
- For partition 1 of table space DBNI1601.TSNI1601 and partition 4 of table space DBNI1601.TSNI1602, reset ACHKP status.
- For partitions 1 and 4 of table space DBNI1601.TSNI1601, reset CHKP status.

```
//STEP3    EXEC DSNUPROC,UID='JUNIU116.RECV1',
//            UTPROC='',SYSTEM='SSTR'
//SYSIN    DD *
  REPAIR OBJECT
  SET INDEX (ALL) TABLESPACE DBNI1601.TSNI1601 NORBDPEND
  SET INDEX (ALL) TABLESPACE DBNI1601.TSNI1602 NORBDPEND
  SET TABLESPACE DBNI1601.TSNI1601 PART 1 NOAUXCHKP
  SET TABLESPACE DBNI1601.TSNI1602 PART 4 NOAUXCHKP
  SET TABLESPACE DBNI1601.TSNI1602 PART 1 NOCHECKPEND
  SET TABLESPACE DBNI1601.TSNI1602 PART 4 NOCHECKPEND
/*
```

Figure 79. REPAIR SET example control statement

Example: Updating version information

The control statement in this example specifies that REPAIR is to update the version information in the catalog and directory for table spaces TLKQAST1, TSKQAST2, and TPKQAST3.

```
//STEP1    EXEC DSNUPROC,UID='JUKQU3AS.REPAIR',TIME=1440,
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSIN    DD *
  REPAIR VERSIONS TABLESPACE DBKQAST1.TLKQAST1
  REPAIR VERSIONS TABLESPACE DBKQAST2.TSKQAST2
  REPAIR VERSIONS TABLESPACE DBKQAST3.TPKQAST3
```

Figure 80. REPAIR VERSIONS example control statement

Example: Repairing a table space with clones

The control statement specifies that REPAIR is to reset the auxiliary CHECK-pending (ACHKP) status of the specified table space and process only the specified objects that are table spaces that contain clone tables, indexes on clone tables, or index spaces that contain indexes on clone tables.

```
REPAIR
    SET TABLESPACE DBKQDB01.TPKQDB01
    NOAUXCHKP CLONE
```

Example: Checking for incorrect information in the catalog

Assume that you ran the DSN1COPY utility and want to make sure that you did not introduce any data integrity errors. DB2 automatically detects any data and catalog inconsistencies the first time that the data set is physically open after being populated by DSN1COPY. However, if you want to proactively check for these inconsistencies, you can use REPAIR. In this case, suppose that one of the affected table spaces is DBNAMET01.TSNAMET01. Issue the following REPAIR statement:

```
REPAIR CATALOG TABLESPACE DBNAMET01.TSNAMET01 TEST
```

This utility control statement specifies that REPAIR is to check for any inconsistencies between the data and catalog. If any inconsistencies are found, DB2 returns messages for them but does not correct them.

If you want REPAIR to correct the catalog when possible, issue the statement without the TEST option, as follows:

```
REPAIR CATALOG TABLESPACE DBNAMET01.TSNAMET01
```

For more information about which inconsistencies are automatically corrected and which are reported through messages, see the description of CATALOG in “Syntax

and options of the REPAIR control statement" on page 664

Chapter 31. REPORT

The REPORT utility provides information about table spaces, tables, and indexes. You can use REPORT to find the names of related table spaces, such as referentially related table spaces and LOB table spaces. You can also use REPORT to find information that is necessary for recovery.

Output

The output from REPORT with the TABLESPACESET option consists of the names of all table spaces in the table space set that you specify. It also lists all tables in the table spaces and all tables that are dependent on those tables.

The output from REPORT with the RECOVERY option consists of the following items:

- The recovery history from the SYSIBM.SYSCOPY catalog table
- Log ranges from the SYSIBM.SYSLGRNX directory table
- Volume serial numbers where archive log data sets from the BSDS exist.
- Information about any indexes on the table space that are in the informational COPY-pending (ICOPY) status (This information affects the recoverability of an index.)
- Information about any system-level backup copies that you can use for recovery if the BACKUP SYSTEM utility is used on your system

  If you use system-level backup copies as the base for object-level recoveries of individual table spaces or index spaces, the REPORT output also lists the system-level backup copies. These copies are listed in the SYSCOPY ROWS AND SYSTEM-LEVEL BACKUPS section of the report.

If REPORT TABLESPACESET or REPORT RECOVERY is specified and the base objects have been cloned, information for both base and clone objects are included in the output.

In a data sharing environment, the REPORT output provides:

- The RBA of when DB2 was migrated to Version 11
- The high and low RBA values of the migrated member
- A list of any SYSLGRNX records from before data sharing was enabled that cannot be used to recover to any point in time after data sharing was enabled
- For SYSCOPY, the member from which the image copy was deleted
- Information about system-level backup copies that are retrieved from the bootstrap data sets of each member in the data sharing group
- The status of deactivated members, and of destroyed members whose member IDs have not been reclaimed

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

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Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required:

To execute this utility, you must use a privilege set that includes one of the following authorities:

- RECOVERDB privilege for the database
- DBADM or DBCTRL authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- DATAACCESS authority
- SYSCTRL or SYSADM authority

Any of the following IDs can run the REPORT utility on any table space in DSNDB01 (the directory) or DSNDB06 (the catalog)

- An ID with DBCTRL or DBADM authority over database DSNDB06
- Any ID with installation SYSOPR, SYSCTRL, or SYSADM authority.

Execution phases of REPORT

The REPORT utility operates in these phases:

Phase Description

UTILINIT
Performs initialization

REPORT
Collects information

UTILTERM
Performs cleanup

Related concepts:

"Preparing for recovery by using the COPY utility" on page 175

Related tasks:

Deleting data sharing members (DB2 Data Sharing Planning and Administration)

Restoring deactivated data sharing members (DB2 Data Sharing Planning and Administration)

Related reference:

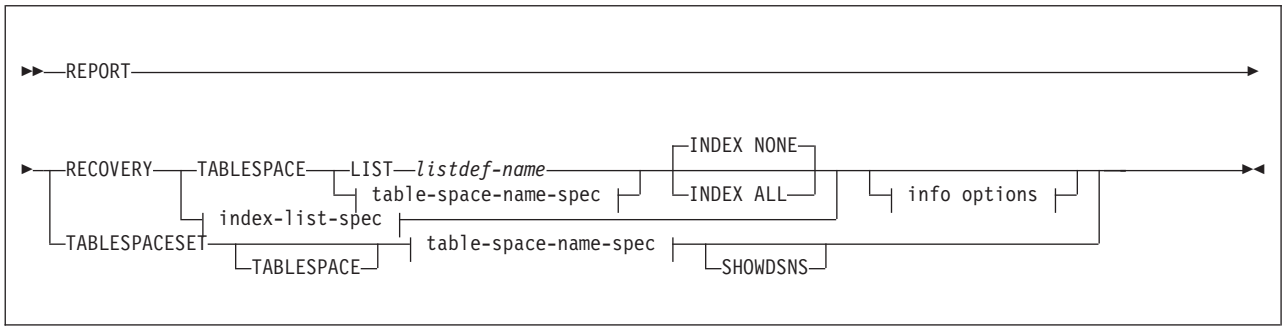
"Informational COPY-pending status" on page 1108

Syntax and options of the REPORT control statement

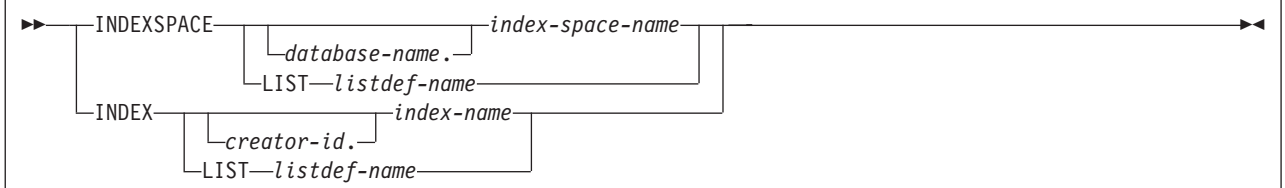
The REPORT utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After you create it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

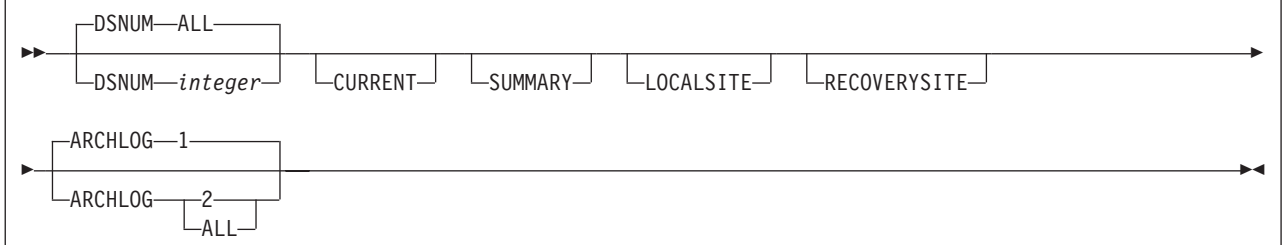
Syntax diagram



index-list-spec:



info options:



Option descriptions

RECOVERY
Indicates that recovery information for the specified table space or index is to be reported.

You can request recovery information for the local site, the recovery site, or both by using the LOCALSITE and RECOVERSITE options. If you request recovery information about the catalog and directory, specify the CURRENT option to avoid unnecessary mounting of archive tapes.

Recommendation: For image copies of partitioned table spaces that are taken with the DSNUM ALL option, run REPORT RECOVERY DSNUM ALL. If you run REPORT RECOVERY DSNUM ALL CURRENT, DB2 reports extra historical information that dates back to the last full image copy that was taken for the entire table space.

For a description of the information that REPORT RECOVERY provides, see "REPORT output" on page 700.

TABLESPACE *database-name.table-space-name*
For REPORT RECOVERY, specifies the table space (and, optionally, the database to which it belongs) that is being reported.

For REPORT TABLESPACESET, specifies a table space (and, optionally, the database to which it belongs) in the table space set.

database-name
Optionally specifies the database to which the table space belongs.

table-space-name
Specifies the table space.

LIST*listdef-name*

Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each control statement of REPORT. The list must contain only table spaces. Do not specify LIST with the TABLESPACE...*table-space-name* specification. The TABLESPACE keyword is required to validate the contents of the list. REPORT RECOVERY TABLESPACE is invoked once per item in the list.

SHOWDSNS
Specifies that the VSAM data set names for each table space or index space are to be included in the TABLESPACESET report. Data set names for base objects are shown in the section titled TABLESPACE SET REPORT. Data set names for CLONE objects are shown in the section titled CLONE TABLESPACE SET REPORT. The later report is only prepared if the base objects have been cloned.

INDEXSPACE *database-name.index-space-name*
Specifies the index space that is being reported.

database-name
Optionally specifies the database to which the index space belongs.

index-space-name
Specifies the index space name for the index that is being reported.

LIST *listdef-name*

Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each control statement of REPORT. The list must contain only index spaces. Do not specify LIST with the INDEXSPACE *index-space-name* specification. The INDEXSPACE keyword is required in order to validate the contents of the list. REPORT RECOVERY INDEXSPACE is invoked once for each item in the list.

INDEX *creator-id.index-name*
Specifies the index in the index space that is being reported.

creator-id
Optionally specifies the creator of the index.

index-name
Specifies the index name that is to be reported. Enclose the index name in quotation marks if the name contains a blank.

LIST *listdef-name*

Specifies the name of a previously defined LISTDEF list name. The utility allows one LIST keyword for each control statement of REPORT. The list must contain only index spaces. Do not specify LIST with the INDEX...*index-name* specification. The INDEX keyword is required to validate the contents of the list. REPORT RECOVERY INDEX is invoked once for each item in the list.

The partitions or partition ranges can be specified in a list.

The following REPORT keywords are optional:

INDEX NONE
Specifies that recovery information for index spaces that are associated with the specified table space is not to be reported.

INDEX ALL
Specifies that recovery information for index spaces that are associated with the specified table space is to be reported.

DSNUM
Identifies a partition or data set for which information is to be reported. Alternatively, DSNUM specifies that information is to be reported for the entire table space or index space.

ALL
Specifies that information is to be reported for the entire table space or index space.

integer
Is the number of a partition or data set for which information is to be reported. The maximum is 4096.

For a partitioned table space or partitioned index space, the integer is its physical partition number.

For a nonpartitioned table space, find the integer at the end of the data set name, as cataloged in the VSAM catalog. The data set name has the following format:

catname.DSNDB*x*.*dbname*.*tsname*.*y*0001.A*nnn*

In this format:

catname
Is the VSAM catalog name or alias.

x Is C or D.

dbname
Is the database name.

tsname Is the table space name.

y Is I or J.

nnn Is the data set integer.

CURRENT
Specifies that only the SYSCOPY entries that were written after the last recovery point of the table space are to be reported. The last recovery point is the last full image copy, LOAD REPLACE LOG YES image copy, or REORG LOG YES image copy. If you specify DSNUM ALL, the last recovery point is a full image copy that was taken for the entire table space or index space. If you specify the CURRENT option, but the last recovery point does not exist on the active log, DB2 prompts you to mount archive tapes until this point is found.

CURRENT also reports only the SYSLGRNX rows and archive log volumes that were created after the last incremental image copy entry. If no incremental image copies were created, only the SYSLGRNX rows and archive log volumes that were created after the last recovery point are reported.

If you do not specify CURRENT or if no last recovery point exists, all SYSCOPY and SYSLGRNX entries for that table space or index space are reported. The report includes entries on archive logs. If you do not specify CURRENT, the entries that were written after the last recovery point are marked with an asterisk (*) in the report.

SUMMARY
Specifies that only a summary of volume serial numbers is to be reported. It reports the following volume serial numbers:
- Where the archive log data sets from the BSDS exist
- Where the image copy data sets from SYSCOPY exist

If you do not specify SUMMARY, recovery information is reported, in addition to the summary of volume serial numbers.

LOCALSITE
Specifies that all SYSCOPY records that were copied from a local site system are to be reported.

RECOVERYSITE
Specifies that all SYSCOPY records that were copied from the recovery site system are to be reported.

ARCHLOG
Specifies which archive log data sets are to be reported.

1 Reports archive log data set 1 only.

2 Reports archive log data set 2 only.

ALL
Reports both archive log data sets 1 and 2.

TABLESPACESET
Indicates that the names of all table spaces in the table space set and the names of all indexes on those tables are to be reported.

For more information about table space sets, see the description of the TABLESPACESET option of the QUIESCE utility.

Related information:

"Syntax and options of the QUIESCE control statement" on page 416

Related reference:

Chapter 19, "LISTDEF," on page 221

Data sets that REPORT uses

The REPORT utility uses a number of data sets during its operation.

The following table lists the data sets that REPORT uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 105. Data sets that REPORT uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space
Object that is to be reported.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for REPORT

The REPORT utility has certain concurrency and compatibility characteristics associated with it.

REPORT does not set a utility restrictive state on the target table space or partition.

REPORT can run concurrently on the same target object with any utility or SQL operation.

Running REPORT on the catalog and directory

REPORT RECOVERY shows the image copies for those table spaces that are not included in SYSIBM.SYSCOPY: DSNDB01.SYSUTILX, DSNDB01.DBD01, DSNDB06.SYSTSCPY, and DSNDB01.SYSDBDXA.

When you run REPORT RECOVERY on one of these table spaces, specify the CURRENT option to avoid unnecessarily mounting archive tapes. If you do not specify CURRENT, DB2 searches for and reports all SYSCOPY records in the log, including those records on archive tapes. If you specify CURRENT, DB2 prompts you to mount archive tapes only if the last recovery point does not exist on the active log. You are prompted to mount tapes until the last recovery point is found.

You can use REPORT TABLESPACESET on the DB2 catalog and directory table spaces.

Termination or restart of REPORT

You can terminate and restart the REPORT utility.

You can terminate a REPORT utility job with the **TERM UTILITY** command if you have submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart a REPORT utility job, but it starts from the beginning again.

Related tasks:

"Restarting an online utility" on page 52

REPORT output

The output from the REPORT utility depends on whether the TABLESPACESET or RECOVERY option is specified.

For the TABLESPACESET option, the output consists of the names of all table spaces in the specified table space set. For the RECOVERY option, the output includes information about the image copy data sets and archive log data set that might be required during the recovery.

REPORT TABLESPACESET output

The output from REPORT TABLESPACESET consists of the names of all table spaces in the table space set that you specify. It also identifies all tables in the table spaces and all tables that are dependent on those tables, including LOB and XML tables, history tables, and archive tables.

Example of REPORT TABLESPACESET output

The statement REPORT TABLESPACESET TABLESPACE DSN8D81A.DSN8S81D generates the output that is shown in the following figure. For the purposes of this example, an XML column was added to the sample table DSN8910.DEPT.

```
DSNU000I    270 14:18:14.71 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = REP94
DSNU1044I   270 14:18:14.91 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    270 14:18:14.92 DSNUGUTC - REPORT TABLESPACESET TABLESPACE DSN8D91A.DSN8S91D
DSNU587I  ) 270 14:18:14.94 DSNUPSET - REPORT TABLESPACE SET WITH TABLESPACE DSN8D91A.DSN8S91D

TABLESPACE SET REPORT:

TABLESPACE         : DSN8D91A.DSN8S91D
```

```
  TABLE            : DSN8910.DEPT
  INDEXSPACE       : DSN8D91A.XDEPT1
  INDEX            : DSN8910.XDEPT11
  INDEXSPACE       : DSN8D91A.XDEPT2
  INDEX            : DSN8910.XDEPT22
  INDEXSPACE       : DSN8D91A.XDEPT3
  INDEX            : DSN8910.XDEPT33
  INDEXSPACE       : DSN8D91A.IRDOCIDD
  INDEX            : DSN8910.I_DOCIDDEPT
  DEP  TABLE       : DSN8910.DEPT
                     DSN8910.EMP
                     DSN8910.PROJ

TABLESPACE         : DSN8D91A.DSN8S91E
  TABLE            : DSN8910.EMP
  INDEXSPACE       : DSN8D91A.XEMP1
  INDEX            : DSN8910.XEMP11
  INDEXSPACE       : DSN8D91A.XEMP2
  INDEX            : DSN8910.XEMP22
  DEP  TABLE       : DSN8910.DEPT
                     DSN8910.EMPPROJACT
                     DSN8910.PROJ

TABLESPACE         : DSN8D91A.DSN8S91P
  TABLE            : DSN8910.ACT
  INDEXSPACE       : DSN8D91A.XACT1
  INDEX            : DSN8910.XACT11
  INDEXSPACE       : DSN8D91A.XACT2
  INDEX            : DSN8910.XACT22
  DEP  TABLE       : DSN8910.PROJACT

  TABLE            : DSN8910.EMPPROJACT
  INDEXSPACE       : DSN8D91A.XEMPPROJ
  INDEX            : DSN8910.XEMPPROJACT1
  INDEXSPACE       : DSN8D91A.XEMP1AQJ
  INDEX            : DSN8910.XEMPPROJACT2

  TABLE            : DSN8910.PROJ
  INDEXSPACE       : DSN8D91A.XPROJ1
  INDEX            : DSN8910.XPROJ11
  INDEXSPACE       : DSN8D91A.XPROJ2
  INDEX            : DSN8910.XPROJ22
  DEP  TABLE       : DSN8910.PROJ
                     DSN8910.PROJACT

  TABLE            : DSN8910.PROJACT
  INDEXSPACE       : DSN8D91A.XPROJAC1
  INDEX            : DSN8910.XPROJAC11
  DEP  TABLE       : DSN8910.EMPPROJACT

XML TABLESPACE SET REPORT:

TABLESPACE               : DSN8D91A.DSN8S91D

  BASE TABLE             : DSN8910.DEPT
  COLUMN                 : XML1
    XML TABLESPACE       : DSN8D91A.XDEP0000
      XML TABLE          : DSN8910.XDEPT
      XML NODEID INDEXSPACE: DSN8D91A.IRNODEID
      XML NODEID INDEX   : DSN8910.I_NODEIDXDEPT

DSNU580I    270 14:18:14.94 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    270 14:18:14.97 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 81. Example of REPORT TABLESPACESET output

Example of REPORT TABLESPACESET output for tables spaces that are included in versioning relationships

The output from REPORT TABLESPACESET identifies versioning relationships in the system-period temporal table space or history table space. The report also includes the related auxiliary LOB and XML table spaces on both the system-period temporal table space and history table spaces.

```
TABLESPACE : DBSOL11.TS001L11
  TABLE                      : ADMF001.TBWSOL11
  INDEXSPACE                 : DBSOL11.IRDOCIDT
  INDEX                      : ADMF001.I_DOCIDTBWSOL11

LOB TABLESPACE SET REPORT:


TABLESPACE : DBSOL11.TS001L11

  BASE TABLE                 : ADMF001.TBWSOL11
  COLUMN                     : BLOB1
    LOB TABLESPACE           : DBSOL11.TLWB1L11
       AUX TABLE             : ADMF001.TBAWLOBB1L11
       AUX INDEXSPACE        : DBSOL11.IXDLB1L1
       AUX INDEX             : ADMF001.IXDLB1L1


TABLESPACE : DBSOL11.TS001L11
  BASE TABLE                 : ADMF001.TBWSOL11
  COLUMN                     : XML1
    XML TABLESPACE           : DBSOL11.XTBW0000
       XML TABLE             : ADMF001.XTBWSOL11
       XML NODEID INDEXSPACE : DBSOL11.IRNODEID
       XML NODEID INDEX      : ADMF001.I_NODEIDXTBWSOL11
       XML INDEXSPACE        : DBSOL11.IXW11SOL
       XML INDEX             : ADMF001.IXW11SOL11
       XML INDEXSPACE        : DBSOL11.IXW12SOL
       XML INDEX             : ADMF001.IXW12SOL11
       XML INDEXSPACE        : DBSOL11.IXW13SOL
       XML INDEX             : ADMF001.IXW13SOL11
       XML INDEXSPACE        : DBSOL11.IXW14SOL
       XML INDEX             : ADMF001.IXW14SOL11

HISTORY TABLESPACE SET REPORT:

  BASE TABLE : ADMF001.TBWSOL11
     HISTORY TABLESPACE      : DBSOL11.HTS001L11
     HISTORY TABLE           : ADMF001.HTBWSOL11
     HISTORY INDEXSPACE      : DBSOL11.HIRDOCIDT
     HISTORY INDEX           : ADMF001.HI_DOCIDTBWSOL11

HISTORY LOB TABLESPACE SET REPORT:

  HISTORY TABLESPACE         : DBSOL11.HTS001L11

  BASE TABLE : ADMF001.TBWSOL11
  COLUMN : BLOB1
    HISTORY LOB TABLESPACE   : DBSOL11.HTLWB1L11
       AUX TABLE             : ADMF001.HTBAWLOBB1L11
       AUX INDEXSPACE        : DBSOL11.HIXDLB1L1
       AUX INDEX             : ADMF001.HIXDLB1L1

HISTORY XML TABLESPACE SET REPORT:

  HISTORY TABLESPACE         : DBSOL11.HTS001L11
```

```
  BASE TABLE : ADMF001.TBWSOL11
  COLUMN : XML1
    HISTORY XML TABLESPACE   : DBSOL11.HXTBW0000
       XML TABLE             : ADMF001.HXTBWSOL11
       XML NODEID INDEXSPACE : DBSOL11.HIRNODEID
       XML NODEID INDEX      : ADMF001.HI_NODEIDXTBWSOL11
       XML INDEXSPACE        : DBSOL11.HIXW11SOL
       XML INDEX             : ADMF001.HIXW11SOL11
       XML INDEXSPACE        : DBSOL11.HIXW12SOL
       XML INDEX             : ADMF001.HIXW12SOL11
       XML INDEXSPACE        : DBSOL11.HIXW13SOL
       XML INDEX             : ADMF001.HIXW13SOL11
       XML INDEXSPACE        : DBSOL11.HHIXW14SOL
       XML INDEX             : ADMF001.HIXW14SOL11
```

Figure 82. Example of REPORT TABLESPACESET output for versioning relationships

Example of REPORT TABLESPACESET output for tables spaces that are included in archive relationships

The following portion of output from REPORT TABLESPACESET shows related archive objects.

```
...
ARCHIVE TABLESPACE SET REPORT:

TABLESPACE         : DB516803.TU516806
  ARCHIVE TABLE    : SC516801.TB_STOCK_PBR_ARCH
  AR_ENABLED TABLE : SC516801.TB_STOCK_PART
  INDEXSPACE       : DB516803.IX01RARC
  INDEX            : SC516801.IX01_ARCH_STOCK_PBR
  INDEXSPACE       : DB516803.IU01RARC
  INDEX            : SC516801.IU01_ARCH_STOCK_PBR
  INDEXSPACE       : DB516803.IX02RARC
  INDEX            : SC516801.IX02_ARCH_STOCK_PBRT

TABLESPACE         : DB516807.TU516808
  ARCHIVE TABLE    : SC516801.TB_ORDERLINE_PBR_ARCH
  AR_ENABLED TABLE : SC516801.TB_ORDERLINE_PBG
  INDEXSPACE       : DB516807.IU01RARC
  INDEX            : SC516801.IU01_ARCH_ORDERLINE_PBR
  INDEXSPACE       : DB516807.IRDO1JOL
  INDEX            : SC516801.I_DOCIDTB_ORDERLINE_PBR_A
  INDEXSPACE       : DB516807.IX01RARC
  INDEX            : SC516801.IX01_ARCH_ORDERLINE_PBR
  INDEXSPACE       : DB516807.IX02RARC
  INDEX            : SC516801.IX02_ARCH_ORDERLINE_PBR
```

Figure 83. Example of REPORT TABLESPACESET output for archive relationships

Related information:

Archive-enabled tables and archive tables (Introduction to DB2 for z/OS)

REPORT RECOVERY output

REPORT RECOVERY displays all information about the image copy data sets and archive log data sets that might be required during the recovery. Specifically, REPORT RECOVERY displays the following information, each in a separate section:

- Recovery information from the SYSIBM.SYSCOPY catalog table, including the history of the following utilities: QUIESCE, COPY, LOAD, REORG, RECOVER TOCOPY, and RECOVER TORBA (or TOLOGPOINT). For each entry, the output indicates the device type and whether the copy is the primary or backup copy for the local site or the recovery site.

  If the SYSTEM_LEVEL_BACKUPS subsystem parameter is set to YES, your DB2 for z/OS subsystem is configured to support object-level recoveries. In this case, the output also includes information about any system-level backup copies that can be used to recover an individual table space or index space.

  If the DSVOLSER column of SYSIBM.SYSCOPY is blank, REPORT RECOVERY does not display volume serial numbers for image copy data sets.
- Log ranges of the table space from the SYSIBM.SYSLGRNX directory.
- Information from archive log data sets ARCHLOG1, ARCHLOG2, or both from the bootstrap data set.
- Information about any system-level backup copies that can be used for recovery. This information is included at the end of the report in a section that begins with the following message:

  DSNU598I - *csect-name* REPORT RECOVERY SYSTEM-LEVEL BACKUPS

If REPORT has no data to display for one or more of these sections, the corresponding sections of the report contain the following message:

DSNU588I - NO DATA TO BE REPORTED

REPORT uses the following delimiters around the ICTYPE value to indicate certain entries:

*** *** REPORT uses asterisks to denote any non-image copy entries in the SYSIBM.SYSCOPY catalog table. For example, an entry that is added by the QUIESCE utility is marked with asterisks in the REPORT output.

 # # REPORT uses number signs to denote any entries in the SYSIBM.SYSCOPY catalog table that were created before any ALTER operations were materialized. For SYSIBM.SYSCOPY entries that were inserted during the materialization of the pending definition changes, REPORT uses asterisks to denote them as non-COPY entries.

< > REPORT uses the less than symbol and greater than symbol to denote an image copy that was made before table space partitions were rebalanced.

( ) REPORT uses parentheses to denote an image copy that was made before a LOG(NO) event. For image copies of indexes, the LOG(NO) event might have occurred on its underlying table space.

Example of REPORT RECOVERY

The following figure shows a sample of REPORT RECOVERY output in a data sharing environment.

```
DSNU050I    277 11:56:29.12 DSNUGUTC -  REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101
DSNU581I  ) 277 11:56:29.13 DSNUPREC - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101
DSNU593I  ) 277 11:56:29.14 DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
             MINIMUM   RBA: 000000000000
             MAXIMUM   RBA: FFFFFFFFFFFF
             MIGRATING RBA: 000000000000
DSNU582I  ) 277 11:56:29.14 DSNUPPCP - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101
                                       SYSCOPY ROWS AND SYSTEM-LEVEL BACKUPS

TIMESTAMP = 2006-10-04-11.54.18.812785,  IC TYPE = *C*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =0000374F6154
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = L,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
```

```
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   =         ,     AUTHID =           ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                 CPAGESF = -1.0E+00
DSNAME    = DBUV0101.TPUV0101                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2009-05-14-06.49.53.121879,  TYPE    = SLB ,                              RBLP = 000231F06000
TOKEN     = E5C1F1C1C42D950789A533D31000001DAEB9       , MEMBER NAME =   , DATA COMPLETE LRSN=0000375F6180

TIMESTAMP = 2006-10-04-11.55.49.489595,  IC TYPE = *R*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00003763616B
DEV TYPE  =         ,                 IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE = RRF
JOBNAME   = TJJ11008,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                 CPAGESF = -1.0E+00
DSNAME    = DBUV0101.TPUV0101                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-10-04-11.56.24.997616,  IC TYPE =  F ,  SHR LVL = R,  DSNUM    = 0000,
            START LRSN =000037775646
DEV TYPE  = 3390    ,                 IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0016,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = TJJ11011,     AUTHID =   ADMF001 ,     COPYPAGESF =  1.49E+02
NPAGESF   =  1.49E+02           ,                 CPAGESF =  1.33E+02
DSNAME    = KUUVT101.COPY.STEP1.SYSCOPY1                , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

DSNU586I  ) 277 11:56:29.14 DSNUPSUM - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101 SUMMARY
DSNU588I  ) 277 11:56:29.14 DSNUPSUM - NO DATA TO BE REPORTED

/DSNU583I  ) 277 11:56:29.14 DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY
              FOR TABLESPACE DBUV0101.TPUV0101
```

UCDATE	UCTIME	START RBA	STOP RBA	START LRSN	STOP LRSN	PARTITION	MEMBER ID
100406	11541904	0000374F86EC	00003752195A	BF8110CF0ADF	BF8110D0EB95	0001	0000
100406	11541916	0000374FB0E1	00003752195A	BF8110CF26BE	BF8110D0EC6F	0002	0000
100406	11541929	0000374FDACA	00003752195A	BF8110CF4606	BF8110D0ECEE	0003	0000
100406	11541940	000037500483	00003752195A	BF8110CF6209	BF8110D0ED64	0004	0000
100406	11541952	000037502E23	00003752195A	BF8110CF7F04	BF8110D0EE47	0005	0000
100406	11541964	00003750582E	00003752195A	BF8110CF9AFD	BF8110D0EED8	0006	0000
100406	11541975	0000375081E7	00003752195A	BF8110CFB7D6	BF8110D0EF51	0007	0000
100406	11541987	00003750AB87	00003752195A	BF8110CFD3C4	BF8110D0EFCC	0008	0000
100406	11541998	00003750D540	00003752195A	BF8110CFEFD4	BF8110D0F052	0009	0000
100406	11542010	00003750FEE0	00003752195A	BF8110D00D2F	BF8110D0F0D6	0010	0000
100406	11542022	0000375128A2	00003752195A	BF8110D02A7E	BF8110D0F157	0011	0000
100406	11542035	00003751525B	00003752195A	BF8110D04860	BF8110D0F204	0012	0000
100406	11542046	000037517BFB	00003752195A	BF8110D06558	BF8110D0F350	0013	0000
100406	11542059	00003751A674	00003752195A	BF8110D083D9	BF8110D0F413	0014	0000
100406	11542074	00003751D02D	00003752195A	BF8110D0A7D6	BF8110D0F4DF	0015	0000
100406	11542087	00003751FA0B	00003752195A	BF8110D0C759	BF8110D0F567	0016	0000
100406	11542199	00003752B0F9	0000375C2734	BF8110D1D925	BF8110F9EE17	0001	0000
100406	11542201	00003752B4C1	0000375C275E	BF8110D1DDFD	BF8110F9EF2E	0002	0000
100406	11542202	00003752B84D	0000375C27D2	BF8110D1E02B	BF8110F9EFC8	0003	0000
100406	11542202	00003752BBD9	0000375C2846	BF8110D1E252	BF8110F9F050	0004	0000
100406	11542203	00003752BF65	0000375C28BA	BF8110D1E495	BF8110F9F0DB	0005	0000
100406	11542205	00003752C31E	0000375C292E	BF8110D1E75F	BF8110F9F160	0006	0000
100406	11542205	00003752C6AA	0000375C29A2	BF8110D1E9C9	BF8110F9F1E2	0007	0000
100406	11542206	00003752CA36	0000375C2A16	BF8110D1EC01	BF8110F9F27D	0008	0000
100406	11542207	00003752CDC2	0000375C2A8A	BF8110D1EE6B	BF8110F9F2FF	0009	0000
100406	11542209	00003752D1A4	0000375C2AFE	BF8110D1F14C	BF8110F9F390	0010	0000
100406	11542210	00003752D530	0000375C2B72	BF8110D1F3C8	BF8110F9F469	0011	0000
100406	11542211	00003752D8BC	0000375C2BE6	BF8110D1F65D	BF8110F9F4ED	0012	0000
100406	11542212	00003752DC48	0000375C2C5A	BF8110D1F8B9	BF8110F9F58E	0013	0000
100406	11542213	00003752E000	0000375C2CCE	BF8110D1FB35	BF8110F9F64A	0014	0000
100406	11542214	00003752E38C	0000375C2D42	BF8110D1FE1E	BF8110F9F6DF	0015	0000

```
 100406    11542215   00003752E718   0000375C2DB6   BF8110D20107   BF8110F9F7A1     0016         0000
 100406    11555014   000037641512   000037666079   BF811125EB99   BF8111266663     0001         0000
 100406    11555015   0000376434E7   0000376661A7   BF811125EDEB   BF8111266709     0002         0000
 100406    11555017   00003764A0F2   000037666303   BF811125F276   BF8111266796     0003         0000
 100406    11555022   00003764C7F9   00003766645F   BF811125FD5C   BF811126682C     0004         0000
 100406    11555025   00003764E702   0000376665BB   BF8111260503   BF81112668A9     0005         0000
 100406    11555027   00003765060B   000037666717   BF81112609DA   BF8111266922     0006         0000
 100406    11555028   000037652514   000037666873   BF8111260DA8   BF81112669F5     0007         0000
 100406    11555031   00003765441D   0000376669CF   BF8111261384   BF8111266A77     0008         0000
 100406    11555032   000037656326   000037666B2B   BF81112616B4   BF8111266B08     0009         0000
 100406    11555033   00003765822F   000037666C87   BF81112619C9   BF8111266BA3     0010         0000
 100406    11555035   00003765A138   000037666DE3   BF8111261D27   BF8111266C63     0011         0000
 100406    11555036   00003765C041   000037666F3F   BF811126207C   BF8111266CE5     0012         0000
 100406    11555037   00003765E033   0000376670E8   BF8111262398   BF8111266D5F     0013         0000
 100406    11555039   000037660033   000037667244   BF811126281F   BF8111266DD6     0014         0000
 100406    11555041   000037662033   0000376673A0   BF8111262BA7   BF8111266E50     0015         0000
 100406    11555042   000037664033   0000376674FC   BF8111262F1D   BF8111266F25     0016         0000
 100406    11555264   00003767877D   0000376FB01E   BF8111284DEB   BF8111357B9B     0001         0000
 100406    11555266   00003767C8C1   0000376FB452   BF8111285307   BF811135809D     0002         0000
 100406    11555270   000037682610   0000376FB6C6   BF8111285B65   BF811135868A     0003         0000
 100406    11555273   0000376856B9   0000376FB93A   BF8111286213   BF8111358C26     0004         0000
 100406    11555276   00003768D63D   0000376FBBAE   BF8111286AB6   BF8111359150     0005         0000
 100406    11555279   0000376936AB   0000376FBE22   BF81112870D0   BF811135970F     0006         0000
 100406    11555282   00003769A5DE   0000376FC10C   BF8111287812   BF8111359D87     0007         0000
 100406    11555285   00003769F6C1   0000376FC380   BF811128800C   BF811135A49D     0008         0000
 100406    11555287   0000376A3819   0000376FC5F4   BF8111288438   BF811135AA33     0009         0000
 100406    11555288   0000376A88FC   0000376FC868   BF811128887F   BF811135AF57     0010         0000
 100406    11555291   0000376B1487   0000376FCADC   BF8111288E59   BF811135B50D     0011         0000
 100406    11560588   0000376BB087   0000376FCD50   BF811134ED6F   BF811135B990     0012         0000
 100406    11560591   0000376C2F10   0000376FD000   BF811134F463   BF811135BFE2     0013         0000
 100406    11560594   0000376C9EB8   0000376FD274   BF811134FC1B   BF811135C5E9     0014         0000
 100406    11560597   0000376D0CE6   0000376FD4E8   BF8111350379   BF811135CB34     0015         0000
 100406    11560599   0000376D4ED1   0000376FD75C   BF81113507F8   BF811135CF65     0016         0000

DSNU584I  ) 277 11:56:29.14 DSNUPPBS - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101 ARCHLOG1
    BSDS VOLUMES
DSNU588I  ) 277 11:56:29.14 DSNUPPBS - NO DATA TO BE REPORTED

DSNU586I  ) 277 11:56:29.14 DSNUPSUM - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101 SUMMARY
DSNU588I  ) 277 11:56:29.14 DSNUPSUM - NO DATA TO BE REPORTED
DSNU589I  ) 277 11:56:29.14 DSNUPREC - REPORT RECOVERY TABLESPACE DBUV0101.TPUV0101 COMPLETE

DSNU598I  @ 134 06:52:53.42 DSNUPPBK - REPORT RECOVERY SYSTEM-LEVEL BACKUPS

            START STCK                            DATA COMPLETE   DATA/LOG COMPLETE
DATA              LOG                  RBLP          LRSN         DATE      LTIME    LOCATION NAME
----------------  ----------------  ------------  ------------  --------------------  ---------------
C42EFEE0E13F45D0  0000000000000000  100000470146  1000004AD112  2009/05/14  06:53:03  STLEC1
TOKEN = E5C1F1C1C42EFEE0E13F45D0100000470146      INCREMENTAL = Y, SUBSYSTEM ID = VA1A, MEMBER NAME = MEM1
Z/OS = 1.11,  CAPTURE CATALOG INFO = N,   LOG COPY POOL = N
C42D950789A533D3  0000000000000000  1000001DAEB9  100000231F06  2009/05/13  03:54:09  STLEC1
TOKEN = E5C1F1C1C42D950789A533D31000001DAEB9      INCREMENTAL = Y, SUBSYSTEM ID = VA1A, MEMBER NAME = MEM2
Z/OS = 1.11,  CAPTURE CATALOG INFO = N,   LOG COPY POOL = N

DSNU580I    277 11:56:29.14 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
```

Example of REPORT RECOVERY with ARCHLOG

The following figure shows sample output for the statement REPORT RECOVERY TABLESPACE ARCHLOG ALL. In message DSNU584I, the archive log entries after the last recovery point are marked with an asterisk (*). If you specify the CURRENT option, message DSNU584I includes only the archive logs after the last recovery point and the asterisk (*) is not included in the report.

```
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = D7058005.RCVR3
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  REPORT RECOVERY TABLESPACE DB580501.TS580501 ARCHLOG ALL
DSNU581I  = DSNUPREC - REPORT RECOVERY TABLESPACE DB580501.TS580501
```

```
DSNU593I  = DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
'             MINIMUM   RBA: 000000000000
'             MAXIMUM   RBA: FFFFFFFFFFFF
'             MIGRATING RBA: 000000000000
DSNU582I  = DSNUPPCP - REPORT RECOVERY TABLESPACE DB580501.TS580501 SYSCOPY ROWS
TIMESTAMP = 2002-09-17-10.03.16.784238,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E58E60D
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 3648 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951105,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2002-09-17-10.03.22.937931,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E5956A3
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951105,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2002-09-17-10.03.43.118193,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E5A7B9D
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 3648 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951106,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2002-09-17-10.03.53.881540,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E5ADC6E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951106,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =
            INSTANCE = 01, RELCREATED = M
TIMESTAMP = 2002-09-17-10.04.02.955333,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E624A3C
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 3648 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951106,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =
            INSTANCE = 01, RELCREATED = M
DSNU586I  = DSNUPSUM - REPORT RECOVERY TABLESPACE DB580501.TS580501 SUMMARY
DSNU588I  = DSNUPSUM - NO DATA TO BE REPORTED

DSNU583I  = DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY FOR TABLESPACE DB580501.TS580501
UCDATE     UCTIME      START RBA      STOP  RBA     START LRSN     STOP  LRSN    PARTITION   MEMBER ID
091702    10025977   00001E4FD319   00001E4FEB91   00001E4FD319   00001E4FEB91     0000         0000     *
091702    10030124   00001E505B93   00001E58BC23   00001E505B93   00001E58BC23     0000         0000     *
091702    10032302   00001E59A637   00001E5A5258   00001E59A637   00001E5A5258     0000         0000     *
091702    10035391   00001E5B26AB   00001E6222F3   00001E5B26AB   00001E6222F3     0000         0000     *
```

```
DSNU584I  = DSNUPPBS - REPORT RECOVERY TABLESPACE DB580501.TS580501 ARCHLOG1 BSDS VOLUMES
START TIME       END TIME    START RBA      END RBA    UNIT  VOLSER   DATA SET NAME
20022601702454 20022601704156 00001E48B000 00001E629FFF SYSDA  SCR03  DSNC810.ARCHLOG1.A0000005     *
DSNU584I  = DSNUPPBS - REPORT RECOVERY TABLESPACE DB580501.TS580501 ARCHLOG2 BSDS VOLUMES
DSNU588I  = DSNUPPBS - NO DATA TO BE REPORTED
DSNU586I  = DSNUPSUM - REPORT RECOVERY TABLESPACE DB580501.TS580501 SUMMARY
                  ARCHLOG1 BSDS VOLSER(S)            SCR03  *
        DSNU589I  = DSNUPREC - REPORT RECOVERY TABLESPACE DB580501.TS580501 COMPLETE

DSNU580I    DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
DSNU000I    DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = D7058005.RCVR3
DSNU1044I   DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    DSNUGUTC -  REPORT RECOVERY TABLESPACE DB580501.TS580501 CURRENT
DSNU581I  = DSNUPREC - REPORT RECOVERY TABLESPACE DB580501.TS580501
DSNU585I  = DSNUPREC - REPORT RECOVERY TABLESPACE DB580501.TS580501 CURRENT
DSNU593I  = DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
'             MINIMUM   RBA: 000000000000
'             MAXIMUM   RBA: FFFFFFFFFFFF
'             MIGRATING RBA: 000000000000
DSNU582I  = DSNUPPCP - REPORT RECOVERY TABLESPACE DB580501.TS580501 SYSCOPY ROWS
TIMESTAMP = 2002-09-17-10.03.16.784238,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E58E60D
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 3648 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951105,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =   ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2002-09-17-10.03.22.937931,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E5956A3
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951105,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =   ,
            INSTANCE = 01, RELCREATED = M
...

TIMESTAMP = 2002-09-17-10.04.02.955333,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00001E624A3C
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 3648 ,
            LOGGED = Y,   TTYPE =
JOBNAME   = T3951106,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                       CPAGESF = -1.0E+00
DSNAME    = DB580501.TS580501                             ,   MEMBER NAME =   ,
            INSTANCE = 01, RELCREATED = M

DSNU586I  = DSNUPSUM - REPORT RECOVERY TABLESPACE DB580501.TS580501 SUMMARY
DSNU588I  = DSNUPSUM - NO DATA TO BE REPORTED

DSNU583I  = DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY FOR TABLESPACE DB580501.TS580501
UCDATE     UCTIME      START RBA      STOP  RBA     START LRSN     STOP  LRSN    PARTITION   MEMBER ID
091702    10025977   00001E4FD319   00001E4FEB91   00001E4FD319   00001E4FEB91     0000         0000
091702    10030124   00001E505B93   00001E58BC23   00001E505B93   00001E58BC23     0000         0000
091702    10032302   00001E59A637   00001E5A5258   00001E59A637   00001E5A5258     0000         0000
091702    10035391   00001E5B26AB   00001E6222F3   00001E5B26AB   00001E6222F3     0000         0000

DSNU584I  = DSNUPPBS - REPORT RECOVERY TABLESPACE DB580501.TS580501 ARCHLOG1 BSDS VOLUMES
```

```
START TIME       END TIME    START RBA      END RBA    UNIT  VOLSER   DATA SET NAME
20022601702454 20022601704156 00001E48B000 00001E629FFF SYSDA  SCR03  DSNC810.ARCHLOG1.A0000005

DSNU586I  = DSNUPSUM - REPORT RECOVERY TABLESPACE DB580501.TS580501 SUMMARY
               ARCHLOG1 BSDS VOLSER(S)            SCR03
DSNU589I  = DSNUPREC - REPORT RECOVERY TABLESPACE DB580501.TS580501 COMPLETE
DSNU580I    DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
```

Figure 84. Example of REPORT RECOVERY TABLESPACE ARCHLOG

Example of determining unusable copies

You can use REPORT RECOVERY output to determine whether any image copies are unusable. Image copies that were taken before REORG or LOAD events that reset REORG-pending status are marked as unusable. In the REPORT RECOVERY output, look at the IC TYPE and STYPE fields to help you determine which image copies are unusable.

For example, in the sample REPORT RECOVERY output in the following figure, the value in the first **IC TYPE** field, *R*, indicates that a LOAD REPLACE LOG YES operation occurred. The value in the second **IC TYPE** field, <F> indicates that a full image copy was taken.

```
DSNU582I  ) 271 15:02:09.92 DSNUPPCP - REPORT RECOVERY TABLESPACE DBKQAA01.TPKQAA01 SYSCOPY ROWS
TIMESTAMP = 2006-09-28-15.00.07.773906,  IC TYPE = *C*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =000037940EEC
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = L,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   =         ,     AUTHID =           ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DBKQAA01.TPKQAA01                             , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-28-15.00.36.940517,  IC TYPE = *R*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =000037A07DAC
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = TJI11004,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DBKQAA01.TPKQAA01                             , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M
```

Figure 85. Sample REPORT RECOVERY output before table space placed in REORG-pending status

After this image copy was taken, assume that an event occurred that put the table space in REORG-pending status. The following figure shows the next several rows of REPORT RECOVERY output for the same table space. The value in the first **ICTYPE** field, *X* indicates that a REORG LOG YES event occurred. In the same SYSCOPY record, the value in the **STYPE** field, A, indicates that this REORG job reset the REORG-pending status. Any image copies that are taken before this status was reset are unusable. (Thus, the full image copy in the REPORT output in the previous figure is unusable.) The next record contains an F in the **IC TYPE** field and an X in the **STYPE** field, which indicates that a full image copy was taken during the REORG job. This image copy is usable.

```
TIMESTAMP = 2006-09-28-15.02.03.978248,  IC TYPE = *X*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =000037B8F661
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = A,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0026,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = TJI11006,     AUTHID =   ADMF001 ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DBKQAA01.TPKQAA01                             , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-28-15.02.09.789597,  IC TYPE =  F,  SHR LVL = R,  DSNUM    = 0000,
            START LRSN =000037CD653E
DEV TYPE  = 3390    ,                    IC BACK =   ,   STYPE   = X,,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0026,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = TJI11006,     AUTHID =   ADMF001 ,     COPYPAGESF =  1.89E+02
NPAGESF   =  1.64E+02           ,                  CPAGESF =  1.64E+02
DSNAME    = JUKQU1AA.REORG1.STEP1.SYSCOPY                 , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M
DS VOLSER = SCR03 ,
```

Figure 86. Sample REPORT RECOVERY output after REORG-pending status is reset

Related reference:

SYSIBM.SYSCOPY table (DB2 SQL)

"Syntax and options of the REPORT control statement" on page 695

Sample REPORT control statements

Use the sample control statements as models for developing your own REPORT control statements.

Example 1: Reporting recovery information for a table space

The following control statement specifies that the REPORT utility is to provide recovery information for table space DSN8D81A.DSN8S81E.

```
//REORG EXEC DSNUPROC,SYSTEM=V91A,UID='REP97'
//SYSIN    DD *
REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E
/*
```

The preceding statement produces output similar to the following output:

```
DSNU000I    270 13:00:51.35 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = REP97
DSNU1044I   270 13:00:51.58 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    270 13:00:51.60 DSNUGUTC -  REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E
DSNU581I  ) 270 13:00:51.60 DSNUPREC - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E
DSNU593I  ) 270 13:00:51.61 DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
             MINIMUM   RBA: 000000000000
             MAXIMUM   RBA: FFFFFFFFFFFF
             MIGRATING RBA: 000000000000
DSNU582I  ) 270 13:00:51.61 DSNUPPCP - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SYSCOPY ROWS
TIMESTAMP = 2006-09-27-11.40.56.074739,  IC TYPE = *C*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00003697A903
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = L,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   =         ,     AUTHID =           ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                             , MEMBER NAME =         ,
```

```
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.38.341008,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0004,
            START LRSN =000036C8EA3E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0004,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                   CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.38.341008,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0001,
            START LRSN =000036C8EA3E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0001,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                   CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M
TIMESTAMP = 2006-09-27-11.41.38.341008,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0002,
            START LRSN =000036C8EA3E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0002,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                   CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.38.341008,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0003,
            START LRSN =000036C8EA3E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0003,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                   CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

. . .
DSNU586I  ) 270 13:00:51.61 DSNUPSUM - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SUMMARY
DSNU588I  ) 270 13:00:51.61 DSNUPSUM - NO DATA TO BE REPORTED

DSNU583I  ) 270 13:00:51.61 DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY FOR TABLESPACE DSN8D91A.DSN8S91E
 UCDATE     UCTIME      START RBA      STOP  RBA     START LRSN     STOP  LRSN    PARTITION   MEMBER ID
 092706    11405634   00003697B82E   0000369855C3   BF7840C34BF3   BF7840C44D81     0001         0000
 092706    11405670   00003697E223   0000369855C3   BF7840C3A2F9   BF7840C44E27     0002         0000
 092706    11405707   000036980BC3   0000369855C3   BF7840C3FF60   BF7840C44E92     0003         0000
 092706    11405732   000036983674   0000369855C3   BF7840C43C57   BF7840C44F03     0004         0000
 092706    11410155   0000369E31B6   000036ADE99C   BF7840C8436A   BF7840D832E3     0001         0000
 092706    11410156   0000369E3ABB   000036A03DB6   BF7840C84546   BF7840D83495     0002         0000
 092706    11410156   0000369E3E51   000036A0E15C   BF7840C84683   BF7840D8359B     0003         0000
 092706    11410159   0000369E4224   000036A5F932   BF7840C84CAA   BF7840D83704     0004         0000
 092706    11413835   000036C98000   000036D0B672   BF7840EB5CF9   BF7840EBF7A3     0001         0000
 092706    11413845   000036CA937C   000036D0B9B6   BF7840EB7562   BF7840EC0150     0002         0000
 092706    11413861   000036CC1F1B   000036D0BC2A   BF7840EB9B43   BF7840EC0983     0004         0000
 092706    11422002   000036FC9A0B   000036FCBA50   BF7841131913   BF7841131F84     0003         0000
 092706    11422074   000036FCEB37   000036FD2000   BF784113C93E   BF784113E333     0003         0000
 092706    11422688   00003701A7B0   000037029A20   BF784119A438   BF78411B9857     0003         0000
 092706    11423828   000037091000   0000370930BF   BF784124848C   BF7841248A06     0005         0000
```

```
 092706    11424418   0000370DC5B7   0000370E625D   BF78412A23C8   BF78412A5DC6     0001         0000
 092706    11424419   0000370DE4FC   0000370E63B9   BF78412A2786   BF78412A6101     0002         0000
 092706    11424421   0000370E0405   0000370E6515   BF78412A2A82   BF78412A6191     0003         0000
 092706    11424427   0000370E230E   0000370E6671   BF78412A39CD   BF78412A6210     0004         0000
 092706    11424428   0000370E4254   0000370E74C2   BF78412A3CFD   BF78412A630C     0005         0000
 092706    11424782   0000370F3DF8   0000371086F8   BF78412D9C67   BF78412DFDE7     0001         0000
 092706    11424787   0000370F41BA   0000371089A8   BF78412DA8F9   BF78412E02FB     0002         0000
 092706    11424791   0000370F44E6   000037108C1C   BF78412DB256   BF78412E0B57     0003         0000
 092706    11424794   0000370F4812   000037108E90   BF78412DBAC1   BF78412E106B     0004         0000
 092706    11424798   0000370F4B3E   00003710919C   BF78412DC398   BF78412E14AE     0005         0000
 092706    11424871   000037111E5F   00003711222E   BF78412E7581   BF78412E7A75     0001         0000
 092706    11424880   000037112516   00003711287E   BF78412E8CD5   BF78412E910F     0002         0000
 092706    11424886   000037112B66   000037112ECE   BF78412E9A46   BF78412E9EF3     0003         0000
 092706    11424893   0000371131D0   000037113538   BF78412EAAFB   BF78412EAF6F     0004         0000
 092706    11424898   000037113820   000037113B88   BF78412EB8A5   BF78412EC1C4     0005         0000

DSNU584I  ) 270 13:00:51.61 DSNUPPBS - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E ARCHLOG1 BSDS VOLUMES
DSNU588I  ) 270 13:00:51.61 DSNUPPBS - NO DATA TO BE REPORTED

DSNU586I  ) 270 13:00:51.61 DSNUPSUM - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SUMMARY
DSNU588I  ) 270 13:00:51.61 DSNUPSUM - NO DATA TO BE REPORTED
DSNU589I  ) 270 13:00:51.61 DSNUPREC - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E COMPLETE

DSNU580I    270 13:00:51.61 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    270 13:00:51.62 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 87. Example output for REPORT RECOVERY

Example 2: Reporting table spaces with LOB columns

The following control statement specifies that REPORT is to provide a list of all table spaces that are related to TABLESPACE DSN8D91L.DSN8S91B, which contains a table with three LOB columns. The output includes a separate section titled LOB TABLESPACE SET REPORT showing a list of related LOB table spaces and their tables, indexes, and index spaces. The base table and column to which each LOB object is related is also shown.

```
REPORT TABLESPACESET TABLESPACE DSN8D91L.DSN8S91B
```

The preceding statement produces output similar to the following output:

```
DSNU000I    277 11:19:09.40 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = REP98
DSNU1044I   277 11:19:09.59 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    277 11:19:09.59 DSNUGUTC -  REPORT TABLESPACESET TABLESPACE DSN8D91L.DSN8S91B
DSNU587I  ) 277 11:19:09.62 DSNUPSET - REPORT TABLESPACE SET WITH TABLESPACE DSN8D91L.DSN8S91B

TABLESPACE SET REPORT:

TABLESPACE         : DSN8D91L.DSN8S91B
  TABLE            : DSN8910.EMP_PHOTO_RESUME
  INDEXSPACE       : DSN8D91L.XEMPRPHO
  INDEX            : DSN8910.XEMP_PHOTO_RESUME


LOB TABLESPACE SET REPORT:

TABLESPACE                 : DSN8D91L.DSN8S91B

  BASE TABLE               : DSN8910.EMP_PHOTO_RESUME
  COLUMN                   : PSEG_PHOTO
    LOB TABLESPACE         : DSN8D91L.DSN8S91L
      AUX TABLE            : DSN8910.AUX_PSEG_PHOTO
      AUX INDEXSPACE       : DSN8D91L.XAUXRPSE
      AUX INDEX            : DSN8910.XAUX_PSEG_PHOTO
```

```
  COLUMN                  : BMP_PHOTO
    LOB TABLESPACE        : DSN8D91L.DSN8S91M
      AUX TABLE           : DSN8910.AUX_BMP_PHOTO
      AUX INDEXSPACE      : DSN8D91L.XAUXRBMP
      AUX INDEX           : DSN8910.XAUX_BMP_PHOTO
  COLUMN                  : RESUME
    LOB TABLESPACE        : DSN8D91L.DSN8S91N
      AUX TABLE           : DSN8910.AUX_EMP_RESUME
      AUX INDEXSPACE      : DSN8D91L.XAUXREMP
      AUX INDEX           : DSN8910.XAUX_EMP_RESUME

DSNU580I    277 11:19:09.62 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    277 11:19:09.62 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 88. Example output for REPORT TABLESPACESET

Example 3: Reporting recovery information for a partition of a partitioned table space

The following control statement specifies that REPORT is to provide recovery information for partition 4 of table space DSN8D91A.DSN8S91E. The partition number is indicated by the DSNUM option.

```
REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E DSNUM 4
```

The preceding statement produces output similar to the following output:

```
DSNU000I    271 18:15:27.26 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = REP99
DSNU1044I   271 18:15:27.55 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    271 18:15:27.55 DSNUGUTC -  REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E DSNUM 4
DSNU581I  ) 271 18:15:27.62 DSNUPREC - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E
DSNU593I  ) 271 18:15:27.66 DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
             MINIMUM   RBA: 000000000000
             MAXIMUM   RBA: FFFFFFFFFFFF
             MIGRATING RBA: 000000000000
DSNU582I  ) 271 18:15:27.66 DSNUPPCP - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SYSCOPY ROWS
TIMESTAMP = 2006-09-27-11.40.56.074739,  IC TYPE = *C*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =00003697A903
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = L,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   =         ,     AUTHID =           ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                            , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.38.341008,  IC TYPE = *Z*,  SHR LVL =  ,  DSNUM    = 0004,
            START LRSN =000036C8EA3E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0004,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00            ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                            , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.51.120054,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =000036E2BA9E
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
```

```
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.53.524797,  IC TYPE = *F*,  SHR LVL = R,  DSNUM    = 0000,
            START LRSN =000036E883E4
DEV TYPE  = 3390    ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0004,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF =  5.7E+01
NPAGESF   =  6.7E+01           ,                  CPAGESF =  5.7E+01
DSNAME    = DB2V91A.SYSCOPY.DSN8D91A.DSN8S91E           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.41.55.631749,  IC TYPE = *Q*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =000036EA809A
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = W,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0000,   HIGH DSNUM = 0000,   OLDEST VERSION = 0001,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M
TIMESTAMP = 2006-09-27-11.42.48.167991,  IC TYPE = *X*,  SHR LVL =  ,  DSNUM    = 0000,
            START LRSN =0000370CA39B
DEV TYPE  =         ,                    IC BACK =   ,   STYPE   = A,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0005,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF = -1.0E+00
NPAGESF   = -1.0E+00           ,                  CPAGESF = -1.0E+00
DSNAME    = DSN8D91A.DSN8S91E                           , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

TIMESTAMP = 2006-09-27-11.42.49.027488,  IC TYPE =  F ,  SHR LVL = R,  DSNUM    = 0000,
            START LRSN =000037113E08
DEV TYPE  = 3390    ,                    IC BACK =   ,   STYPE   = X,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0005,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = DSNTEJ1 ,     AUTHID =   SYSADM  ,     COPYPAGESF =  2.0E+01
NPAGESF   =  1.6E+01           ,                  CPAGESF =  1.6E+01
DSNAME    = DB2V91A.DSN8D91A.DSN8S91E.REORGCPY          , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

DSNU586I  ) 271 18:15:27.66 DSNUPSUM - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SUMMARY
DSNU588I  ) 271 18:15:27.66 DSNUPSUM - NO DATA TO BE REPORTED

DSNU583I  ) 271 18:15:27.66 DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY FOR TABLESPACE DSN8D91A.DSN8S91E
 UCDATE     UCTIME      START RBA      STOP  RBA     START LRSN     STOP  LRSN    PARTITION   MEMBER ID
 092706    11405732   000036983674   0000369855C3   BF7840C43C57   BF7840C44F03     0004         0000
 092706    11410159   0000369E4224   000036A5F932   BF7840C84CAA   BF7840D83704     0004         0000
 092706    11413861   000036CC1F1B   000036D0BC2A   BF7840EB9B43   BF7840EC0983     0004         0000
 092706    11424427   0000370E230E   0000370E6671   BF78412A39CD   BF78412A6210     0004         0000
 092706    11424794   0000370F4812   000037108E90   BF78412DBAC1   BF78412E106B     0004         0000
 092706    11424893   0000371131D0   000037113538   BF78412EAAFB   BF78412EAF6F     0004         0000

DSNU584I  ) 271 18:15:27.66 DSNUPPBS - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E ARCHLOG1 BSDS VOLUMES
DSNU588I  ) 271 18:15:27.66 DSNUPPBS - NO DATA TO BE REPORTED

DSNU586I  ) 271 18:15:27.66 DSNUPSUM - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E SUMMARY
DSNU588I  ) 271 18:15:27.66 DSNUPSUM - NO DATA TO BE REPORTED
DSNU589I  ) 271 18:15:27.66 DSNUPREC - REPORT RECOVERY TABLESPACE DSN8D91A.DSN8S91E COMPLETE
```

```
DSNU580I    271 18:15:27.66 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    271 18:15:27.67 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 89. Example output for REPORT RECOVERY DSNUM

Example 4: Reporting recovery information for an index

The control statement specifies that REPORT is to provide recovery information for index DSN8810.XDEPT1.

```
//REP101 EXEC DSNUPROC,SYSTEM=V91A,UID='REP101'
//SYSIN    DD *
REPORT RECOVERY INDEX DSN8910.XDEPT1
/*
```

Figure 90. Example REPORT RECOVERY statement for an index

The preceding statement produces output similar to the following output:

```
DSNU000I    270 13:51:08.82 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = REP101
DSNU1044I   270 13:51:09.04 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
DSNU050I    270 13:51:09.04 DSNUGUTC -  REPORT RECOVERY INDEX DSN8910.XDEPT1
DSNU581I  ) 270 13:51:09.05 DSNUPREC - REPORT RECOVERY INDEX DSN8910.XDEPT1
DSNU593I  ) 270 13:51:09.05 DSNUPREC -  REPORT RECOVERY ENVIRONMENT RECORD:
             MINIMUM   RBA: 000000000000
             MAXIMUM   RBA: FFFFFFFFFFFF
             MIGRATING RBA: 000000000000
DSNU582I  ) 270 13:51:09.05 DSNUPPCP - REPORT RECOVERY INDEX DSN8910.XDEPT1   SYSCOPY ROWS
TIMESTAMP = 2006-09-27-13.50.30.627880,  IC TYPE =  F ,  SHR LVL = R,  DSNUM    = 0000,
            START LRSN =00003726ADE3
DEV TYPE  = 3390    ,                    IC BACK =   ,   STYPE   =  ,  FILE SEQ = 0000,
            PIT LRSN  = 000000000000
LOW DSNUM = 0001,   HIGH DSNUM = 0001,   OLDEST VERSION = 0000,   LOGICAL PART = 0000,
            LOGGED = Y,   TTYPE =
JOBNAME   = REP101  ,     AUTHID =   SYSADM  ,     COPYPAGESF =  5.0E+00
NPAGESF   =  5.0E+00           ,                   CPAGESF =  0.0E0
DSNAME    = DSN8D91A.XDEPT1.D2006270.T205030              , MEMBER NAME =         ,
            INSTANCE = 01, RELCREATED = M

DSNU586I  ) 270 13:51:09.05 DSNUPSUM - REPORT RECOVERY INDEX DSN8910.XDEPT1   SUMMARY
DSNU588I  ) 270 13:51:09.05 DSNUPSUM - NO DATA TO BE REPORTED

DSNU583I  ) 270 13:51:09.05 DSNUPPLR - SYSLGRNX ROWS FROM REPORT RECOVERY FOR INDEX DSN8910.XDEPT1
DSNU588I  ) 270 13:51:09.05 DSNUPPLR - NO DATA TO BE REPORTED

DSNU584I  ) 270 13:51:09.05 DSNUPPBS - REPORT RECOVERY INDEX DSN8910.XDEPT1   ARCHLOG1 BSDS VOLUMES
DSNU588I  ) 270 13:51:09.05 DSNUPPBS - NO DATA TO BE REPORTED

DSNU586I  ) 270 13:51:09.05 DSNUPSUM - REPORT RECOVERY INDEX DSN8910.XDEPT1   SUMMARY
DSNU588I  ) 270 13:51:09.05 DSNUPSUM - NO DATA TO BE REPORTED
DSNU589I  ) 270 13:51:09.05 DSNUPREC - REPORT RECOVERY INDEX DSN8910.XDEPT1   COMPLETE

DSNU580I    270 13:51:09.05 DSNUPORT - REPORT UTILITY COMPLETE - ELAPSED TIME=00:00:00
DSNU010I    270 13:51:09.06 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 91. Example output for REPORT RECOVERY INDEX

Example 5: Reporting table space set information with XML columns

The following utility control statement specifies that REPORT is to list all objects that are related to the base table space.

```
REPORT TABLESPACESET TABLESPACE DBKQAN01.TPKQAN01
```

In this example, the base table includes two XML columns. The following output for this REPORT statement lists the objects that were implicitly created to store data for those XML columns.

Figure 92. Example output for REPORT TABLESPACESET

```
TABLESPACE SET REPORT:

TABLESPACE         : DBKQAN01.TPKQAN01
  TABLE            : ADMF001.TBKQAN01
  INDEXSPACE       : DBKQAN01.IPKQAN11
  INDEX            : ADMF001.IPKQAN111
  INDEXSPACE       : DBKQAN01.IRDOCIDT
  INDEX            : ADMF001.I_DOCIDTBKQAN01
  INDEXSPACE       : DBKQAN01.IXKQAN12
  INDEX            : ADMF001.IXKQAN122


XML TABLESPACE SET REPORT:

TABLESPACE                : DBKQAN01.TPKQAN01

  BASE TABLE              : ADMF001.TBKQAN01
  COLUMN                  : XML1
    XML TABLESPACE        : DBKQAN01.XTBK0000
      XML TABLE           : ADMF001.XTBKQAN01
      XML NODEID INDEXSPACE: DBKQAN01.IRNODEID
      XML NODEID INDEX    : ADMF001.I_NODEIDXTBKQAN01
      XML INDEXSPACE      : DBKQAN01.XVIXLC11
      XML INDEX           : ADMF001.XVIXLC11
  COLUMN                  : XML2
    XML TABLESPACE        : DBKQAN01.XTBK0001
      XML TABLE           : ADMF001.XTBKQAN01000
      XML NODEID INDEXSPACE: DBKQAN01.IRNO1MH2
      XML NODEID INDEX    : ADMF001.I_NODEIDXTBKQAN01000
      XML INDEXSPACE      : DBKQAN01.XVIXLC12
      XML INDEX           : ADMF001.XVIXLC12
```

Example 6: Reporting versioning relationships for system-period temporal table spaces

The following utility control statement specifies that REPORT is to list all objects that are related to the base table space.

```
REPORT TABLESPACESET TABLESPACE DBSOL11.TS001L11
```

The following report shows the objects that are involved in versioning relationships. The report also includes related auxiliary LOB and XML table spaces on both the system-period temporal table space and the history table spaces.

```
TABLESPACE SET REPORT:

TABLESPACE         : DBSOL11.TS001L11
  TABLE            : ADMF001.TBWSOL11
  INDEXSPACE       : DBSOL11.IRDOCIDT
  INDEX            : ADMF001.I_DOCIDTBWSOL11
```

```
LOB TABLESPACE SET REPORT:

TABLESPACE            : DBSOL11.TS001L11
  BASE TABLE          : ADMF001.TBWSOL11
  COLUMN              : BLOB1
    LOB TABLESPACE    : DBSOL11.TLWB1L11
    AUX TABLE         : ADMF001.TBAWLOBB1L11
    AUX INDEXSPACE    : DBSOL11.IXDLB1L1
    AUX INDEX         : ADMF001.IXDLB1L1

XML TABLESPACE SET REPORT:

TABLESPACE                  : DBSOL11.TS001L11
  BASE TABLE                : ADMF001.TBWSOL11
  COLUMN                    : XML1
    XML TABLESPACE          : DBSOL11.XTBW0000
       XML TABLE            : ADMF001.XTBWSOL11
       XML NODEID INDEXSPACE : DBSOL11.IRNODEID
       XML NODEID INDEX     : ADMF001.I_NODEIDXTBWSOL11
       XML INDEXSPACE       : DBSOL11.IXW11SOL
       XML INDEX            : ADMF001.IXW11SOL11
       XML INDEXSPACE       : DBSOL11.IXW12SOL
       XML INDEX            : ADMF001.IXW12SOL11
       XML INDEXSPACE       : DBSOL11.IXW13SOL
       XML INDEX            : ADMF001.IXW13SOL11
       XML INDEXSPACE       : DBSOL11.IXW14SOL
       XML INDEX            : ADMF001.IXW14SOL11

HISTORY TABLESPACE SET REPORT:

BASE TABLE                  : ADMF001.TBWSOL11
  HISTORY TABLESPACE        : DBSOL11.HTS001L11
  HISTORY TABLE             : ADMF001.HTBWSOL11
  HISTORY INDEXSPACE        : DBSOL11.HIRDOCIDT
  HISTORY INDEX             : ADMF001.HI_DOCIDTBWSOL11

HISTORY LOB TABLESPACE SET REPORT:

HISTORY TABLESPACE          : DBSOL11.HTS001L11

  BASE TABLE                : ADMF001.TBWSOL11
  COLUMN                    : BLOB1
    HISTORY LOB TABLESPACE  : DBSOL11.HTLWB1L11
    AUX TABLE               : ADMF001.HTBAWLOBB1L11
    AUX INDEXSPACE          : DBSOL11.HIXDLB1L1
    AUX INDEX               : ADMF001.HIXDLB1L1

HISTORY XML TABLESPACE SET REPORT:

HISTORY TABLESPACE          : DBSOL11.HTS001L11

  BASE TABLE                : ADMF001.TBWSOL11
  COLUMN                    : XML1
    HISTORY XML TABLESPACE  : DBSOL11.HXTBW0000
    XML TABLE               : ADMF001.HXTBWSOL11
    XML NODEID INDEXSPACE   : DBSOL11.HIRNODEID
    XML NODEID INDEX        : ADMF001.HI_NODEIDXTBWSOL11
    XML INDEXSPACE          : DBSOL11.HIXW11SOL
    XML INDEX               : ADMF001.HIXW11SOL11
    XML INDEXSPACE          : DBSOL11.HIXW12SOL
    XML INDEX               : ADMF001.HIXW12SOL11
    XML INDEXSPACE          : DBSOL11.HIXW13SOL
    XML INDEX               : ADMF001.HIXW13SOL11
    XML INDEXSPACE          : DBSOL11.HHIXW14SOL
    XML INDEX               : ADMF001.HIXW14SOL11
```

Example 7: Reporting related archive tables

This example uses the following tables:

TB_WAREHOUSE_SEG
An application-period temporal table.

TB_DISTRICT_SEG
A regular table that has a referential constraint that is dependent on table TB_WAREHOUSE_SEG.

TB_STOCK_PART
An archive-enabled table that has a referential constraint that is dependent on table TB_WAREHOUSE_SEG.

TB_ORDER_PBR
A system-period temporal table that has a referential constraint that is dependent on table TB_DISTRICT_SEG.

TB_ORDERLINE_PBG
An archive-enabled table that has referential constraints that are dependent on tables TB_STOCK_PART and TB_ORDER_PBR.

These tables were created by the following SQL:

```
* ------------------------------------------------
*   Table:           SC516801.TB_WAREHOUSE_SEG
*   Unique Index:    SC516801.IU01_WAREHOUSE_SEG
*   Index:           SC516801.IX01_WAREHOUSE_SEG
*                    SC516801.IX02_WAREHOUSE_SEG
*                    SC516801.IX03_WAREHOUSE_SEG
*   Index on Exp:    SC516801.IX04_WAREHOUSE_SEG
*   View:            SC516801.VW_WAREHOUSE_SEG
* ------------------------------------------------
CREATE TABLE SC516801.TB_WAREHOUSE_SEG
      (WAREHOUSE_CREATE_XML1      XML,
       WAREHOUSE_ID        CHAR(10)            NOT NULL WITH DEFAULT
         CONSTRAINT CNST_WAREHOUSEID
         CHECK (WAREHOUSE_ID IN('0000000001','0000000002','0000000003',
                                '0000000004','0000000005','0000000006',
                                '0000000007','0000000008','0000000009',
                                '0000000010')),
       WAREHOUSE_NAME              CHAR(10)       NOT NULL WITH DEFAULT,
       WAREHOUSE_STREET_1          VARCHAR(40)    NOT NULL WITH DEFAULT,
       WAREHOUSE_STREET_2          VARCHAR(40)    FIELDPROC FPCVD4,
       WAREHOUSE_CITY              VARCHAR(20)    NOT NULL WITH DEFAULT,
       WAREHOUSE_STATE             CHAR(2)        NOT NULL WITH DEFAULT,
       WAREHOUSE_ZIP               CHAR(9)        NOT NULL
                                                  DEFAULT '000000000',
       WAREHOUSE_TAX               DECIMAL(5,4)   NOT NULL WITH DEFAULT,
       WAREHOUSE_YTD         SC516801.US_DOLLAR   NOT NULL WITH DEFAULT,
       WAREHOUSE_CREATE_BIGINT1    BIGINT         NOT NULL WITH DEFAULT,
       WAREHOUSE_CREATE_BINARY1    BINARY(101)    NOT NULL WITH DEFAULT,
       WAREHOUSE_CREATE_VARBINARY1 VARBINARY(500) NOT NULL WITH DEFAULT,
       WAREHOUSE_CREATE_DECFLOAT1  DECFLOAT(34)   NOT NULL WITH DEFAULT,
       BUS_START                   DATE           NOT NULL             ,
       BUS_END                     DATE           NOT NULL             ,
       PERIOD BUSINESS_TIME(BUS_START,BUS_END)                         ,
       PRIMARY KEY(WAREHOUSE_ID)
       )
    IN DB516801.TS516801;
COMMIT;
...
* ------------------------------------------------
*   Table:           SC516801.TB_DISTRICT_SEG
*   Unique Index:    SC516801.IU01_DISTRICT_SEG
```

```
|  *   Index:           SC516801.IX01_DISTRICT_SEG
|  *   Index on Exp:    SC516801.IX02_DISTRICT_SEG
|  *   View:            SC516801.VW_DISTRICT_SEG
|  *   LOB table space: TA516801
|  *   Auxiliary Table: SC516801.TX01_CLOB1_DISTRICT_SEG
|  *   Auxiliary Index: SC516801.IA_CLOB1_DISTRICT_SEG
|  * ------------------------------------------------
|  CREATE TABLE SC516801.TB_DISTRICT_SEG
|         (DISTRICT_ID               CHAR(2)         NOT NULL WITH DEFAULT
|            CONSTRAINT CNST_DISTRICTID
|            CHECK (DISTRICT_ID IN('01','02','03','04','05',
|                                  '06','07','08','09','10')),
|          DISTRICT_WAREHOUSE_ID     CHAR(10)        NOT NULL WITH DEFAULT,
|          DISTRICT_NAME             CHAR(20)        NOT NULL WITH DEFAULT,
|          DISTRICT_TAX              DECIMAL(5,4)    NOT NULL WITH DEFAULT,
|          DISTRICT_YTD           SC516801.US_DOLLAR NOT NULL WITH DEFAULT,
|          DISTRICT_NEXT_ORDER_ID    INTEGER         NOT NULL WITH DEFAULT,
|          DISTRICT_STATE            CHAR(2)         NOT NULL WITH DEFAULT,
|          DISTRICT_ZIP              CHAR(9)         NOT NULL WITH DEFAULT,
|          DISTRICT_STREET_1         VARCHAR(40)     NOT NULL WITH DEFAULT,
|          DISTRICT_STREET_2         VARCHAR(40)                 ,
|          DISTRICT_CITY             VARCHAR(20)     NOT NULL WITH DEFAULT,
|          DISTRICT_CREATE_BIGINT1   BIGINT          NOT NULL WITH DEFAULT,
|          DISTRICT_CREATE_BINARY1   BINARY(25)      NOT NULL WITH DEFAULT,
|          DISTRICT_CREATE_DECFLOAT1 DECFLOAT(16)    NOT NULL WITH DEFAULT,
|          DISTRICT_CREATE_CLOB1     CLOB(2K)        NOT NULL WITH DEFAULT,
|        PRIMARY KEY (DISTRICT_WAREHOUSE_ID, DISTRICT_ID),
|        FOREIGN KEY (DISTRICT_WAREHOUSE_ID)
|        REFERENCES  SC516801.TB_WAREHOUSE_SEG(WAREHOUSE_ID)
|           ON DELETE CASCADE)
|        IN DB516801.TS516801;
|  COMMIT;
|  ...
|  * ------------------------------------------------
|  *   Table:           SC516801.TB_STOCK_PART
|  *   Unique Index:    SC516801.IU01_STOCK_PART
|  *   Index:           SC516801.IX01_STOCK_PART
|  *   Index on Exp:    SC516801.IX02_STOCK_PART
|  *   View:            SC516801.VW_STOCK_PART
|  * ------------------------------------------------
|  CREATE TABLE SC516801.TB_STOCK_PART
|     (STOCK_ITEM_ID           CHAR(6)      NOT NULL WITH DEFAULT,
|      STOCK_WAREHOUSE_ID      CHAR(10)     NOT NULL WITH DEFAULT,
|      STOCK_QUANTITY          INTEGER      NOT NULL WITH DEFAULT,
|      STOCK_YTD               INTEGER      NOT NULL WITH DEFAULT,
|      STOCK_ORDER_CNT         SMALLINT     NOT NULL WITH DEFAULT,
|      STOCK_REMOTE_CNT        SMALLINT     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_01       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_02       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_03       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_04       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_05       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_06       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_07       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_08       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_09       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DISTRICT_10       CHAR(24)     NOT NULL WITH DEFAULT,
|      STOCK_DATA              CHAR(50)                          ,
|      STOCK_CREATE_BIGINT1    BIGINT       NOT NULL WITH DEFAULT,
|      STOCK_CREATE_BINARY1    BINARY(50)   NOT NULL WITH DEFAULT,
|      STOCK_CREATE_VARBINARY1 VARBINARY(1000) NOT NULL WITH DEFAULT,
|      STOCK_CREATE_DECFLOAT1  DECFLOAT(34)   NOT NULL WITH DEFAULT,
|      STOCK_CREATE_RCT1       TIMESTAMP    NOT NULL
|                            GENERATED BY DEFAULT FOR EACH ROW ON UPDATE
|                            AS ROW CHANGE TIMESTAMP IMPLICITLY HIDDEN,
|      SYS_START TIMESTAMP(12) NOT NULL WITH DEFAULT                 ,
|      SYS_END   TIMESTAMP(12) NOT NULL WITH DEFAULT                 ,
```

```
|      TRANS_ID  TIMESTAMP(12) NOT NULL WITH DEFAULT                 ,
|      PRIMARY KEY (STOCK_WAREHOUSE_ID, STOCK_ITEM_ID),
|      FOREIGN KEY (STOCK_WAREHOUSE_ID)
|        REFERENCES SC516801.TB_WAREHOUSE_SEG(WAREHOUSE_ID)
|        ON DELETE CASCADE
|      )
|      PARTITION BY (STOCK_WAREHOUSE_ID,STOCK_ITEM_ID)
|         (PARTITION  1 ENDING ('0000000002','999999') ,
|          PARTITION  2 ENDING ('0000000004','999999') ,
|          PARTITION  3 ENDING ('0000000006','999999') ,
|          PARTITION  4 ENDING ('0000000008','999999') ,
|          PARTITION  5 ENDING ('0000000011','999999'))
|      IN DB516803.TP516805;
|  COMMIT;
|  ...
|   ALTER TABLE TB_STOCK_PART
|        ENABLE ARCHIVE USE TB_STOCK_PBR_ARCH;
|  ...
|  * ------------------------------------------------
|  *   Table:           SC516801.TB_ORDER_PBR
|  *   UNIQUE INDEX:    SC516801.IU01_ORDER_PBR
|  *                    SC516801.IU02_ORDER_PBR
|  *                    SC516801.IU03_ORDER_PBR
|  *                    SC516801.IU04_ORDER_PBR
|  *   Index on Exp:    SC516801.IU05_ORDER_PBR
|  *   Index:           SC516801.IX01_ORDER_PBR
|  *                    SC516801.IX02_ORDER_PBR
|  *   View:            SC516801.VW_ORDER_PBR
|  * ------------------------------------------------
|  CREATE TABLE SC516801.TB_ORDER_PBR
|         (ORDER_ID                INTEGER      NOT NULL WITH DEFAULT,
|          ORDER_DISTRICT_ID       CHAR(2)      NOT NULL WITH DEFAULT,
|          ORDER_WAREHOUSE_ID      CHAR(10)     NOT NULL WITH DEFAULT,
|          ORDER_CUSTOMER_ID       INTEGER      GENERATED BY DEFAULT
|                  AS IDENTITY (START WITH 1,INCREMENT BY 1) UNIQUE,
|          ORDER_CARRIER_ID        CHAR(2),
|          ORDER_ORDERLINE_COUNT   SMALLINT     NOT NULL WITH DEFAULT,
|          ORDER_ALL_LOCAL         SMALLINT     NOT NULL WITH DEFAULT,
|          ORDER_ENTRY_DATE        TIMESTAMP    NOT NULL WITH DEFAULT
|                                  '2008-02-01-01.59.59.000000',
|          ORDER_ESTIMATE_DATE     DATE         DEFAULT '2008-01-01',
|          ORDER_ESTIMATE_TIME     TIME         DEFAULT '01.59.59',
|          ORDER_SHIP_DATE         DATE      NOT NULL DEFAULT '2008-01-01',
|          ORDER_SHIP_TIME         TIME      NOT NULL DEFAULT '01.59.59',
|          ORDER_CREATE_VARBINARY1 VARBINARY(500) NOT NULL WITH DEFAULT,
|          ORDER_CREATE_BIGINT1    BIGINT       NOT NULL WITH DEFAULT,
|          ORDER_CREATE_BINARY1    BINARY(80)   NOT NULL WITH DEFAULT,
|          ORDER_CREATE_DECFLOAT1  DECFLOAT(34) NOT NULL WITH DEFAULT
|                                              IMPLICITLY HIDDEN,
|          ORDER_CREATE_CLOB1      CLOB(2K)     NOT NULL WITH DEFAULT,
|          ORDER_CREATE_BLOB1      BLOB(2K)     NOT NULL WITH DEFAULT,
|          ORDER_CREATE_XML        XML                                ,
|          ORDER_CREATE_RCT1       TIMESTAMP    NOT NULL
|                              GENERATED ALWAYS FOR EACH ROW ON UPDATE
|                              AS ROW CHANGE TIMESTAMP
|                              IMPLICITLY HIDDEN,
|          SYS_START TIMESTAMP(12) NOT NULL GENERATED ALWAYS AS ROW BEGIN ,
|          SYS_END   TIMESTAMP(12) NOT NULL GENERATED ALWAYS AS ROW END   ,
|          TRANS_ID TIMESTAMP(12) GENERATED ALWAYS AS TRANSACTION START ID,
|          PERIOD SYSTEM_TIME(SYS_START, SYS_END)                         ,
|       PRIMARY KEY  (ORDER_WAREHOUSE_ID,
|                     ORDER_DISTRICT_ID,
|                     ORDER_ID),
|       FOREIGN KEY  (ORDER_WAREHOUSE_ID,
|                     ORDER_DISTRICT_ID)
|       REFERENCES SC516801.TB_DISTRICT_SEG(DISTRICT_WAREHOUSE_ID,
|                                  DISTRICT_ID)
```

```
|       ON DELETE CASCADE)
|       PARTITION BY (ORDER_ID ASC)
|                   (PARTITION 1 ENDING AT (03000) INCLUSIVE,
|                    PARTITION 2 ENDING    (06000) INCLUSIVE,
|                    PARTITION 3 ENDING    (2147483647) INCLUSIVE)
|       IN DB516803.TU516803;
|  ...
|  ALTER TABLE SC516801.TB_ORDER_PBR
|        ADD VERSIONING USE HISTORY TABLE SC516801.TB_ORDER_SEG_HIST;
|  ...
|  * -------------------------------------------------
|  *   Table:           SC516801.TB_ORDERLINE_PBG bi-temporal table
|  *   Unique Index:    SC516801.IU01_ORDERLINE_PBG
|  *   Index:           SC516801.IX01_ORDERLINE_PBG
|  *   Index on Exp:    SC516801.IX02_ORDERLINE_PBG
|  *   View:            SC516801.VW_ORDERLINE_PBG
|  *-----------------------------------------------------------------
|  CREATE TABLE SC516801.TB_ORDERLINE_PBG
|        (ORDERLINE_CREATE_XML1   XML,
|         ORDERLINE_CREATE_LOB    CLOB(2K)                          ,
|         ORDERLINE_ORDER_ID      INTEGER        NOT NULL WITH DEFAULT,
|         ORDERLINE_DISTRICT_ID   CHAR(2)        NOT NULL WITH DEFAULT,
|         ORDERLINE_WAREHOUSE_ID  CHAR(10)       NOT NULL WITH DEFAULT,
|         ORDERLINE_CATEGORY      SMALLINT       NOT NULL WITH DEFAULT,
|         ORDERLINE_BARCODE1      DOUBLE,
|         ORDERLINE_BARCODE2      REAL,
|         ORDERLINE_BARCODE3      DOUBLE         NOT NULL WITH DEFAULT,
|         ORDERLINE_BARCODE4      REAL           NOT NULL WITH DEFAULT,
|         ORDERLINE_HASH_ENTRY1   CHAR(50)       FOR BIT DATA NOT NULL
|                                                WITH DEFAULT X'C1',
|         ORDERLINE_HASH_ENTRY2   CHAR(50)       FOR BIT DATA,
|         ORDERLINE_UPC01         VARCHAR(100)   FOR BIT DATA,
|         ORDERLINE_UPC02         VARCHAR(100)   FOR BIT DATA NOT NULL
|                                                DEFAULT '<>' ,
|         ORDERLINE_REMARKS       VARCHAR(255)   DEFAULT NULL,
|         ORDERLINE_ITEM_ID       CHAR(6)        NOT NULL WITH DEFAULT,
|         ORDERLINE_SUPPLY_WAREHOUSE_ID CHAR(10) NOT NULL WITH DEFAULT,
|         ORDERLINE_DELIVERY_DATE TIMESTAMP,
|         ORDERLINE_QUANTITY      INTEGER        NOT NULL WITH DEFAULT,
|         ORDERLINE_AMOUNT        US_DOLLAR      NOT NULL WITH DEFAULT,
|         ORDERLINE_DISTRICT_INFO  CHAR(24)      NOT NULL WITH DEFAULT,
|         ORDERLINE_CREATE_DECFLOAT1 DECFLOAT(16)  NOT NULL WITH DEFAULT,
|         ORDERLINE_CREATE_VARBINARY1 VARBINARY(500) NOT NULL WITH DEFAULT,
|         ORDERLINE_CREATE_BIGINT1    BIGINT     NOT NULL WITH DEFAULT,
|         ORDERLINE_CREATE_BINARY1    BINARY(30) NOT NULL WITH DEFAULT,
|         SYS_START TIMESTAMP(12) NOT NULL WITH DEFAULT                ,
|         SYS_END   TIMESTAMP(12) NOT NULL WITH DEFAULT                ,
|         TRANS_ID  TIMESTAMP(12)                                       ,
|         BUS_START              TIMESTAMP(6)  NOT NULL             ,
|         BUS_END                TIMESTAMP(6)  NOT NULL             ,
|       CONSTRAINT PK#TB_ORDERLINE_DISTRICT_ID#ORDER_ID#CATEGORY
|       PRIMARY KEY (ORDERLINE_WAREHOUSE_ID,
|                    ORDERLINE_DISTRICT_ID,
|                    ORDERLINE_ORDER_ID,
|                    ORDERLINE_CATEGORY),
|       CONSTRAINT FK#TB_ORDER#WAREHOUSE_ID#DISTRICT_ID#ORDER_ID#CASCADE
|       FOREIGN KEY (ORDERLINE_WAREHOUSE_ID,
|                    ORDERLINE_DISTRICT_ID,
|                    ORDERLINE_ORDER_ID)
|             REFERENCES SC516801.TB_ORDER_PBR
|                  (ORDER_WAREHOUSE_ID,
|                    ORDER_DISTRICT_ID,
|                    ORDER_ID)
|             ON DELETE CASCADE,
|       CONSTRAINT FK#TB_STOCK_WAREHOUSE_ID#STOCK_ITEM_ID#CASCADE
|       FOREIGN KEY (ORDERLINE_SUPPLY_WAREHOUSE_ID,
|                    ORDERLINE_ITEM_ID)
```

```
            REFERENCES SC516801.TB_STOCK_PART
                 (STOCK_WAREHOUSE_ID,
                  STOCK_ITEM_ID)
            ON DELETE CASCADE)
      IN DB516807.TG516807
      APPEND YES;
...
ALTER TABLE SC516801.TB_ORDERLINE_PBG
       ENABLE ARCHIVE USE SC516801.TB_ORDERLINE_PBR_ARCH;
```

The following utility control statement specifies that REPORT is to list all objects that are related to table space TS516801, which contains tables TB_DISTRICT_SEG and TB_WAREHOUSE_SEG.

```
REPORT TABLESPACESET TABLESPACE DB516801.TS516801
```

The resulting output lists referentially related objects, related LOB and XML tables, and related history and archive tables:

```
TABLESPACE SET REPORT:

TABLESPACE         : DB516801.TS516801
  TABLE            : SC516801.TB_DISTRICT_SEG
  INDEXSPACE       : DB516801.IU01RDIS
  INDEX            : SC516801.IU01_DISTRICT_SEG
  INDEXSPACE       : DB516801.IX01RDIS
  INDEX            : SC516801.IX01_DISTRICT_SEG
  INDEXSPACE       : DB516801.IX02RDIS
  INDEX            : SC516801.IX02_DISTRICT_SEG
  DEP  TABLE       : SC516801.TB_ORDER_PBR

  TABLE            : SC516801.TB_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IU01RWAR
  INDEX            : SC516801.IU01_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IRDOCIDT
  INDEX            : SC516801.I_DOCIDTB_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IX01RWAR
  INDEX            : SC516801.IX01_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IX02RWAR
  INDEX            : SC516801.IX02_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IX03RWAR
  INDEX            : SC516801.IX03_WAREHOUSE_SEG
  INDEXSPACE       : DB516801.IX04RWAR
  INDEX            : SC516801.IX04_WAREHOUSE_SEG
  DEP  TABLE       : SC516801.TB_DISTRICT_SEG
                     SC516801.TB_STOCK_PART

TABLESPACE         : DB516803.TP516805
  TABLE            : SC516801.TB_STOCK_PART
  INDEXSPACE       : DB516803.IX01RSTO
  INDEX            : SC516801.IX01_STOCK_PART
  INDEXSPACE       : DB516803.IU01RSTO
  INDEX            : SC516801.IU01_STOCK_PART
  INDEXSPACE       : DB516803.IX02RSTO
  INDEX            : SC516801.IX02_STOCK_PART
  DEP  TABLE       : SC516801.TB_ORDERLINE_PBG

TABLESPACE         : DB516803.TU516803
  TABLE            : SC516801.TB_ORDER_PBR
  INDEXSPACE       : DB516803.IU01RORD
  INDEX            : SC516801.IU01_ORDER_PBR
  INDEXSPACE       : DB516803.IRDOCIDT
  INDEX            : SC516801.I_DOCIDTB_ORDER_PBR
  INDEXSPACE       : DB516803.IU02RORD
  INDEX            : SC516801.IU02_ORDER_PBR
  INDEXSPACE       : DB516803.IU03RORD
  INDEX            : SC516801.IU03_ORDER_PBR
```

```
|    INDEXSPACE       : DB516803.IU04RORD
|    INDEX            : SC516801.IU04_ORDER_PBR
|    INDEXSPACE       : DB516803.IX01RORD
|    INDEX            : SC516801.IX01_ORDER_PBR
|    INDEXSPACE       : DB516803.IX02RORD
|    INDEX            : SC516801.IX02_ORDER_PBR
|    INDEXSPACE       : DB516803.IU05RORD
|    INDEX            : SC516801.IU05_ORDER_PBR
|    DEP  TABLE       : SC516801.TB_ORDERLINE_PBG
|
|  TABLESPACE         : DB516807.TG516807
|    TABLE            : SC516801.TB_ORDERLINE_PBG
|    INDEXSPACE       : DB516807.IU01RORD
|    INDEX            : SC516801.IU01_ORDERLINE_PBG
|    INDEXSPACE       : DB516807.IRDOCIDT
|    INDEX            : SC516801.I_DOCIDTB_ORDERLINE_PBG
|    INDEXSPACE       : DB516807.IX01RORD
|    INDEX            : SC516801.IX01_ORDERLINE_PBG
|    INDEXSPACE       : DB516807.IX02RORD
|    INDEX            : SC516801.IX02_ORDERLINE_PBG
|
|
|  LOB TABLESPACE SET REPORT:
|
|  TABLESPACE                : DB516801.TS516801
|
|    BASE TABLE              : SC516801.TB_DISTRICT_SEG
|    COLUMN                  : DISTRICT_CREATE_CLOB1
|      LOB TABLESPACE        : DB516801.TA516801
|        AUX TABLE           : SC516801.TX01_CLOB1_DISTRICT_SEG
|        AUX INDEXSPACE      : DB516801.IARCLOB1
|        AUX INDEX           : SC516801.IA_CLOB1_DISTRICT_SEG
|
|  TABLESPACE                : DB516803.TU516803
|
|    BASE TABLE              : SC516801.TB_ORDER_PBR
|    PART: 0001        COLUMN : ORDER_CREATE_CLOB1
|      LOB TABLESPACE        : DB516803.TA516831
|        AUX TABLE           : SC516801.TX31_CLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA31RCLO
|        AUX INDEX           : SC516801.IA31_CLOB_ORDER_PBR
|    PART: 0002        COLUMN : ORDER_CREATE_CLOB1
|      LOB TABLESPACE        : DB516803.TA516832
|        AUX TABLE           : SC516801.TX32_CLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA32RCLO
|        AUX INDEX           : SC516801.IA32_CLOB_ORDER_PBR
|    PART: 0003        COLUMN : ORDER_CREATE_CLOB1
|      LOB TABLESPACE        : DB516803.TA516833
|        AUX TABLE           : SC516801.TX33_CLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA33RCLO
|        AUX INDEX           : SC516801.IA33_CLOB_ORDER_PBR
|    PART: 0001        COLUMN : ORDER_CREATE_BLOB1
|      LOB TABLESPACE        : DB516803.TA516834
|        AUX TABLE           : SC516801.TX31_BLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA31RBLO
|        AUX INDEX           : SC516801.IA31_BLOB_ORDER_PBR
|    PART: 0002        COLUMN : ORDER_CREATE_BLOB1
|      LOB TABLESPACE        : DB516803.TA516835
|        AUX TABLE           : SC516801.TX32_BLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA32RBLO
|        AUX INDEX           : SC516801.IA32_BLOB_ORDER_PBR
|    PART: 0003        COLUMN : ORDER_CREATE_BLOB1
|      LOB TABLESPACE        : DB516803.TA516836
|        AUX TABLE           : SC516801.TX33_BLOB_ORDER_PBR
|        AUX INDEXSPACE      : DB516803.IA33RBLO
|        AUX INDEX           : SC516801.IA33_BLOB_ORDER_PBR
|
```

```
TABLESPACE                : DB516807.TG516807

  BASE TABLE              : SC516801.TB_ORDERLINE_PBG
  PART: 0001        COLUMN : ORDERLINE_CREATE_LOB
    LOB TABLESPACE        : DB516807.TA516871
      AUX TABLE           : SC516801.TX71_CLOB1_ORDERLINE_PBG
      AUX INDEXSPACE      : DB516807.IA71RCLO
      AUX INDEX           : SC516801.IA71_CLOB1_ORDERLINE_PBG


XML TABLESPACE SET REPORT:

TABLESPACE                : DB516801.TS516801

  BASE TABLE              : SC516801.TB_WAREHOUSE_SEG
  COLUMN                  : WAREHOUSE_CREATE_XML1
    XML TABLESPACE        : DB516801.XTBR0000
      XML TABLE           : SC516801.XTB_WAREHOUSE_SEG
      XML NODEID INDEXSPACE: DB516801.IRNODEID
      XML NODEID INDEX    : SC516801.I_NODEIDXTB_WAREHOUSE_SEG

TABLESPACE                : DB516803.TU516803

  BASE TABLE              : SC516801.TB_ORDER_PBR
  COLUMN                  : ORDER_CREATE_XML
    XML TABLESPACE        : DB516803.XTBR0000
      XML TABLE           : SC516801.XTB_ORDER_PBR
      XML NODEID INDEXSPACE: DB516803.IRNODEID
      XML NODEID INDEX    : SC516801.I_NODEIDXTB_ORDER_PBR

TABLESPACE                : DB516807.TG516807

  BASE TABLE              : SC516801.TB_ORDERLINE_PBG
  COLUMN                  : ORDERLINE_CREATE_XML1
    XML TABLESPACE        : DB516807.XTBR0000
      XML TABLE           : SC516801.XTB_ORDERLINE_PBG
      XML NODEID INDEXSPACE: DB516807.IRNODEID
      XML NODEID INDEX    : SC516801.I_NODEIDXTB_ORDERLINE_PBG


HISTORY TABLESPACE SET REPORT:

TABLESPACE        : DB516804.TS516804
  HISTORY TABLE   : SC516801.TB_ORDER_SEG_HIST
  TEMPORAL TABLE  : SC516801.TB_ORDER_PBR
  INDEXSPACE      : DB516804.IU01RORD
  INDEX           : SC516801.IU01_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IRDOCIDT
  INDEX           : SC516801.I_DOCIDTB_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IU02RORD
  INDEX           : SC516801.IU02_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IU03RORD
  INDEX           : SC516801.IU03_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IU04RORD
  INDEX           : SC516801.IU04_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IX01RORD
  INDEX           : SC516801.IX01_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IX02RORD
  INDEX           : SC516801.IX02_ORDER_SEG_HIST
  INDEXSPACE      : DB516804.IU05RORD
  INDEX           : SC516801.IU05_ORDER_SEG_HIST


HISTORY LOB TABLESPACE SET REPORT:

TABLESPACE                : DB516804.TS516804
```

```
|
|    BASE TABLE               : SC516801.TB_ORDER_SEG_HIST
|    COLUMN                   : ORDER_CREATE_CLOB1
|      LOB TABLESPACE         : DB516804.TA516841
|        AUX TABLE            : SC516801.TX41_CLOB_ORDER_SEG_HIST
|        AUX INDEXSPACE       : DB516804.IA41RCLO
|        AUX INDEX            : SC516801.IA41_CLOB_ORDER_SEG_HIST
|    COLUMN                   : ORDER_CREATE_BLOB1
|      LOB TABLESPACE         : DB516804.TA516842
|        AUX TABLE            : SC516801.TX42_BLOB_ORDER_SEG_HIST
|        AUX INDEXSPACE       : DB516804.IA42RBLO
|        AUX INDEX            : SC516801.IA42_BLOB_ORDER_SEG_HIST
|
|
|  HISTORY XML TABLESPACE SET REPORT:
|
|  TABLESPACE                 : DB516804.TS516804
|
|    BASE TABLE               : SC516801.TB_ORDER_SEG_HIST
|    COLUMN                   : ORDER_CREATE_XML
|      XML TABLESPACE         : DB516804.XTBR0000
|        XML TABLE            : SC516801.XTB_ORDER_SEG_HIST
|        XML NODEID INDEXSPACE: DB516804.IRNODEID
|        XML NODEID INDEX     : SC516801.I_NODEIDXTB_ORDER_SEG_HIST
|
|
|
|  ARCHIVE TABLESPACE SET REPORT:
|
|  TABLESPACE         : DB516803.TU516806
|    ARCHIVE TABLE    : SC516801.TB_STOCK_PBR_ARCH
|    AR_ENABLED TABLE : SC516801.TB_STOCK_PART
|    INDEXSPACE       : DB516803.IX01RARC
|    INDEX            : SC516801.IX01_ARCH_STOCK_PBR
|    INDEXSPACE       : DB516803.IU01RARC
|    INDEX            : SC516801.IU01_ARCH_STOCK_PBR
|    INDEXSPACE       : DB516803.IX02RARC
|    INDEX            : SC516801.IX02_ARCH_STOCK_PBRT
|
|  TABLESPACE         : DB516807.TU516808
|    ARCHIVE TABLE    : SC516801.TB_ORDERLINE_PBR_ARCH
|    AR_ENABLED TABLE : SC516801.TB_ORDERLINE_PBG
|    INDEXSPACE       : DB516807.IU01RARC
|    INDEX            : SC516801.IU01_ARCH_ORDERLINE_PBR
|    INDEXSPACE       : DB516807.IRDO1JOL
|    INDEX            : SC516801.I_DOCIDTB_ORDERLINE_PBR_A
|    INDEXSPACE       : DB516807.IX01RARC
|    INDEX            : SC516801.IX01_ARCH_ORDERLINE_PBR
|    INDEXSPACE       : DB516807.IX02RARC
|    INDEX            : SC516801.IX02_ARCH_ORDERLINE_PBR
|
|
|  ARCHIVE LOB TABLESPACE SET REPORT:
|
|  TABLESPACE                 : DB516807.TU516808
|
|    BASE TABLE               : SC516801.TB_ORDERLINE_PBR_ARCH
|    PART: 0001        COLUMN : ORDERLINE_CREATE_LOB
|      LOB TABLESPACE         : DB516807.TA516881
|        AUX TABLE            : SC516801.TX81_CLOB1_ORDERLINE_PBR_ARCH
|        AUX INDEXSPACE       : DB516807.IA81RCLO
|        AUX INDEX            : SC516801.IA81_CLOB1_ORDERLINE_PBR_ARCH
|    PART: 0002        COLUMN : ORDERLINE_CREATE_LOB
|      LOB TABLESPACE         : DB516807.TA516882
|        AUX TABLE            : SC516801.TX82_CLOB1_ORDERLINE_PBR_ARCH
|        AUX INDEXSPACE       : DB516807.IA82RCLO
|        AUX INDEX            : SC516801.IA82_CLOB1_ORDERLINE_PBR_ARCH
```

```
|    PART: 0003        COLUMN : ORDERLINE_CREATE_LOB
|      LOB TABLESPACE         : DB516807.TA516883
|        AUX TABLE            : SC516801.TX83_CLOB1_ORDERLINE_PBR_ARCH
|        AUX INDEXSPACE       : DB516807.IA83RCLO
|        AUX INDEX            : SC516801.IA83_CLOB1_ORDERLINE_PBR_ARCH
|
|
|  ARCHIVE XML TABLESPACE SET REPORT:
|
|  TABLESPACE                 : DB516807.TU516808
|
|    BASE TABLE               : SC516801.TB_ORDERLINE_PBR_ARCH
|    COLUMN                   : ORDERLINE_CREATE_XML1
|      XML TABLESPACE         : DB516807.XTBR0001
|        XML TABLE            : SC516801.XTB_ORDERLINE_PBR_A
|        XML NODEID INDEXSPACE: DB516807.IRNO1LJL
|        XML NODEID INDEX     : SC516801.I_NODEIDXTB_ORDERLINE_PBR_
```

Chapter 32. RESTORE SYSTEM

The RESTORE SYSTEM online utility invokes z/OS DFSMShsm to recover a DB2 subsystem or a data sharing group to a previous point in time. To perform the recovery, the utility uses data that is copied by the BACKUP SYSTEM utility.

Requirements:

- All data sets that are recovered with RESTORE SYSTEM must be SMS-managed.
- In general, RESTORE SYSTEM requires z/OS DFSMShsm Version 1 Release 7 or later.
- RESTORE SYSTEM requires z/OS DFSMShsm Version 1 Release 8 or later for restoring system-level backups that have been dumped to tape.

The RESTORE SYSTEM utility can be run from any member in a data sharing group, even one that is normally quiesced when any backups are taken. Any member in the data sharing group that is active at or beyond the log truncation point must be restarted, and its logs are truncated to the SYSPITR LRSN point.

You can specify the SYSPITR LRSN point in the CRESTART control statement of the DSNJU003 (Change Log Inventory) utility. Any data sharing group member that is normally quiesced at the time the backups are taken and is not active at or beyond the log truncation point does not need to be restarted.

By default, RESTORE SYSTEM recovers the data from the database copy pool during the RESTORE phase and then applies logs to the point in time at which the existing logs were truncated during the LOGAPPLY phase. The RESTORE utility never restores logs from the log copy pool.

Restriction: RESTORE SYSTEM does not restore logs; the utility only applies the logs. If you specified BACKUP SYSTEM FULL to create copies of both the data and the logs, you can restore the logs by another method.

Output:

Output for RESTORE SYSTEM is the recovered copy of the data volume or volumes.

In all migration modes, RBA and LRSN values are displayed in 10-byte format. This 10-byte display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. For recovery purposes, this 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains

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non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

To run this utility, you must use a privilege set that includes SYSADM authority.

The user who submits the job must also have certain RACF authorities if both of the following conditions are true:

- A system-level backup on tape is the input for the RESTORE SYSTEM utility.
- The z/OS level is Version 1 Release 11 or earlier.

In this situation, the following two RACF authorities are required:

- Operations authority, as in ATTRIBUTES=OPERATIONS
- DASDVOL authority, which you can set in the following way:

```
SETROPTS GENERIC(DASDVOL)
REDEFINE DASDVOL * UACC(ALTER)
SETROPTS CLASSACT(DASDVOL)
SETROPTS GENERIC(DASDVOL) REFRESH
```

  You can restrict this authority to specific user IDs.

This RACF authority is required, because the RESTORE SYSTEM utility invokes DFSMSdss when tape is the input and the z/OS level is Version 1 Release 11 or earlier. However, DFSMSdss is not invoked when you restore database copy pools from tape when the z/OS level is Version 1 Release 12 or later or from a FlashCopy on disk. In these situations, the RESTORE SYSTEM utility invokes DFSMShsm, which does not require Operations or DASDVOL authority.

Execution phases of RESTORE SYSTEM

The RESTORE SYSTEM utility operates in the following phases:

Phase Description

UTILINIT
Performs initialization and setup

RESTORE
Locates and restores the volume copies if the LOGONLY option is not specified

LOGAPPLY
Applies the outstanding log changes to the database

UTILTERM
Performs cleanup

Related concepts:

Point-in-time recovery with system-level backups (DB2 Administration Guide)

Related reference:

Chapter 9, “BACKUP SYSTEM,” on page 59

Syntax and options of the RESTORE SYSTEM control statement

The RESTORE SYSTEM utility control statement, with its multiple options, defines the function that the utility job performs.

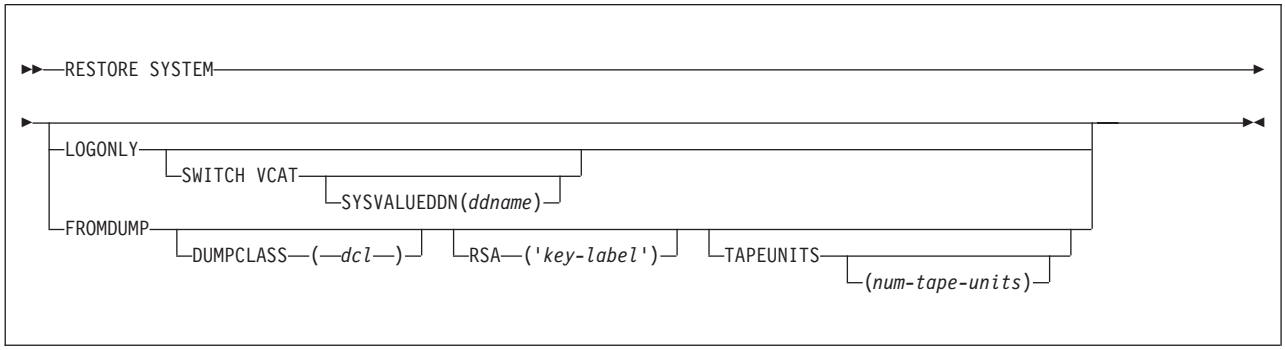
Use the ISPF/PDF edit function to create a control statement and to save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

When you specify RESTORE SYSTEM, you can specify only the following statements in the same step:

- DIAGNOSE
- OPTIONS PREVIEW
- OPTIONS OFF
- OPTIONS KEY
- OPTIONS EVENT WARNING

In addition, RESTORE SYSTEM must be the last statement in SYSIN.

Syntax diagram



Option descriptions

LOGONLY
Specifies that the database volumes have already been restored, so the RESTORE phase is skipped. Use this option when the database volumes have already been restored outside of DB2. If the subsystem is at a tracker site, you must specify the LOGONLY option.

SWITCH VCAT
Indicates that the integrated catalog facility (ICF) alias (VCAT) names are to be substituted with those names that are provided when the log is processed. Every VCAT encountered in the log must be specified in the SYSVALUEDDN data set. This option might be used in the process of cloning a DB2 subsystem.

SYSVALUEDDN ('*ddname***')**
Specifies that the DD statement for the control statements specifying the integrated catalog facility (ICF) (VCAT) aliases used when processing log records.*ddname* can be up to 8 characters, and must start with an alphabetic or national character (for example: @, $, or #).

The default value is SYSVALUEDDN(SYSVALUE), where SYSVALUE identifies the primary data set.

FROMDUMP
Indicates that you want to dump only the database copy pool to tape during the restore.

DUMPCLASS (*dcl*)
Indicates what DFSMShsm dump class to use for the restore.

RSA ('*key-label*')
Specifies that the *key-label* value in the utility control statement is passed to DFSMShsm to override the *key-label* value that would normally be used to read dump tapes. *key-label* can be up to 64 characters, and must start with an alphabetic or national character (for example: @, $, or #). *key-label* must be enclosed in single quotation marks.

The FROMDUMP and DUMPCLASS options that you specify for the RESTORE SYSTEM utility override the RESTORE_ RECOVER_FROMDUMP and UTILS_DUMP_CLASS_NAME subsystem parameter values.

TAPEUNITS
Specifies the limit on the number of tape drives that the utility dynamically allocates during the restore of the database copy pool from dumps on tape.

The default is the option that you specified for subsystem parameter RESTORE_TAPEUNITS. If no default is specified, then the RESTORE SYSTEM utility tries to use all of the tape drives in your system.

The TAPEUNITS option does not apply and is ignored when the z/OS level is Version 1 Release 12 or later.

(*num-tape-units*)
Specifies the maximum number of tape drives to allocate. If you specify zero, or you do not specify a value, the utility determines the optimal number of tape units to use. RESTORE SYSTEM TAPEUNITS has a maximum value of 255.

Related tasks:

Recovering from disasters by using a tracker site (DB2 Administration Guide)

Before running RESTORE SYSTEM

Certain activities might be required before you run the RESTORE SYSTEM utility, depending on your situation.

Complete the following steps prior to running RESTORE SYSTEM:

1. Stop DB2. If data sharing, stop all DB2 members in the group.
2. Run DSNJU003 (Change Log Inventory) to create a DB2 conditional restart record with the CRESTART SYSPITR option. Specify the log truncation point with the SYSPITR option that corresponds to the point in time to which the system is to be recovered.

   For data sharing, specify an LRSN value. For non data sharing, specify an RBA value.

   If you restored the log copy pool and the active log data sets are stripped or the log copy pool is for a data sharing environment, you must specify the data complete LRSN during the conditional restart in the following scenarios:

   - You are cloning a DB2 system by using a system-level backup as the source. In this case, conditionally restart DB2 with an ENDRBA or ENDLRSN that is equal to the data complete LRSN of the system-level backup.
   - You are performing a system-level point-in-time recovery. In this case, conditionally restart DB2 with the log truncation point equal to or less than

the data complete LRSN of the system-level backup. Use the data complete LRSN as the CRESTART ENDRBA, ENDLRSN, or SYSPITR log truncation point.

You can determine the data complete LRSN from the following places:

- Message DSNU1614I, which is generated when BACKUP SYSTEM completes successfully
- The report generated by the print log map utility (DSNJU004)

3. Start DB2. When the DB2 restart processing for the conditional restart with the SYSPITR option completes, DB2 enters system RECOVER-pending and access maintenance mode. During system RECOVER-pending mode, you can run only the RESTORE SYSTEM utility.
4. Ensure that the ICF catalogs for the DB2 data are not active and are not allocated. The ICF catalog for the data must be on a separate volume than the ICF catalog for the logs. The command to unallocate the catalog is `F CATALOG,UNALLOCATE(`*`catalog-name`*`)`. Alternatively, if you add the ICF catalog names to the database copy pool definition by altering the copy pools, the catalog is unallocated by HSM before doing the restore.

Related information:

Altering copy pools (DFSMSdfp Storage Administration)

How to determine which system-level backups DB2 restores

The RESTORE SYSTEM utility uses the most recent system-level backup of the database copy pool that DB2 took before the SYSPITR log truncation point.

To determine whether the system level backup will be restored from disk or from tape:

- If FROMDUMP was not specified and the system-level backup resides on disk, DB2 uses it for the restore.
- If you specify YES in the RESTORE/RECOVER FROM DUMP field on installation panel DSNTIP6 or you specify the FROMDUMP option in the RESTORE utility statement, restore uses only the dumps on tape of the database copy pool.
- If you specify a dump class name on the DUMP CLASS NAME field on installation panel DSNTIP6 or you specify the DUMPCLASS option in the RESTORE utility statement, DB2 restores the database copy pool from the DFSMshsm dump class.
- If you do not specify a dump class name in the DUMP CLASS NAME field on installation panel DSNTIP6 or you do not specify the DUMPCLASS option in the RESTORE utility statement, RESTORE SYSTEM issues the DFSMShsm LIST COPYPOOL command and uses the first dump class listed in the output.

The RESTORE SYSTEM utility invokes DFSMS to restore the database copy pool volumes from a system-level backup on tape. If the z/OS level is Version 1 Release 11 or earlier, the utility invokes DFSMSdss. If the z/OS level is Version 1 Release 12 or later, the utility invokes DFSMShsm.

How to determine if RESTORE SYSTEM uses parallelism when restoring from tapes

Parallelism occurs if the dumps of the volumes in the database copy pool reside on different tape volumes. The degree of parallelism is limited by:

- The TAPEUNITS option, which limits the number of tape units that the utility can allocate.
- The number of distinct tape volumes that the dump resides on.

Determining whether the system-level backups reside on disk or tape

Restoring each volume in the database copy pool from a fast replication copy on the disk occurs virtually instantaneously. Restoring the database copy pool from dumps on tape volumes takes much longer.

To determine whether the system-level backups of the database copy pool reside on the disk or tape:

1. Run the DFSMShsm LIST COPYPOOL command with the ALLVOLS option.
2. Run the DSNJU004 utility output. For data sharing, run the DSNJU004 utility output on each member.
3. Review the output from the DFSMShsm LIST COPYPOOL command with the ALLVOLS option.
4. Review the DB2 system-level backup information in the DSNJU004 utility output.

If the system-level backup chosen as the recovery base for the database copy pool no longer resides on DASD and the FROMDUMP option has not been specified, then the RESTORE SYSTEM utility will fail. You can then specify the RESTORE SYSTEM FROMDUMP option, or specify it on installation panel DSNTIP6, to direct the utility to use the system-level backup that was dumped to tape.

Data sets that RESTORE SYSTEM uses

The RESTORE SYSTEM utility uses a number of data sets during its operation.

The following table lists the data sets that RESTORE SYSTEM uses. The table lists the DD name that is used to identify the data set, a description of the data set, and whether it is required. Include statements in your JCL for each required data set.

Table 106. Data sets that RESTORE SYSTEM uses

Data set	Description	Required?
SYSIN	An input data set that contains the utility control statement	Yes
SYSPRINT	An output data set for messages	Yes
auth-id.job-name.HSM	A temporary data set that is automatically allocated by the utility and deleted when the utility completes	Yes
VCAT alias values data set	An input data set that contains the values of the integrated catalog facility (ICF) alias (VCAT) names to be switched while processing. Specify its DD name with the SYSVALUEDDN option of the utility control statement. The default DD name is SYSVALUE.	No

Data set description

VCAT alias values data set

Defines a set of records which contain integrated catalog facility (ICF) catalog (VCAT) alias names.

Each record must contain a pair of (VCAT) alias names separated by only a comma. Blank characters are not allowed between each name. Each name is a valid z/OS alias of up to eight characters and composed of uppercase alphabetic, numeric, or national characters. The first (VCAT) alias name is the name used when the system level backup was created. The second (VCAT) alias name is the current name after any renaming. All aliases encountered in the log must be specified, even if the VCAT alias is the same as when the system level backup was created. Sample data follows:

```
VCAT1,VCAT2
VCAT5,Z1234567
DSNC000,DSNC000
```

To obtain the names, keep a list of previously existing to current name mappings when renaming an integrated catalog facility (ICF) catalog (VCAT) alias.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for RESTORE SYSTEM

The RESTORE SYSTEM utility has certain concurrency and compatibility characteristics associated with it.

While RESTORE SYSTEM is running, no other utilities can run.

Restoring data in a data sharing environment

Ensure that all data sharing members that were active at the SYSPITR log truncation point (or restarted after this point) have been restarted with the same SYSPITR LRSN value. You can stop the other members of the data group (with MODE(QUIESCE)) after the SYSPITR restart.

Using DISPLAY UTILITY with RESTORE SYSTEM

You can use the DISPLAY UTILITY command with RESTORE SYSTEM.

About this task

To use the DISPLAY UTILITY command for RESTORE SYSTEM on a data sharing group, you must issue the command from the member on which the RESTORE SYSTEM utility is invoked.

Termination and restart of RESTORE SYSTEM

You can terminate and restart the RESTORE SYSTEM utility.

You cannot terminate RESTORE SYSTEM by using the TERM UTILITY command.

You can restart RESTORE SYSTEM at the beginning of a phase or at the current system checkpoint. A current system checkpoint occurs during the LOGAPPLY phase after log records are processed. By default, RESTORE SYSTEM restarts at the current system checkpoint.

When you restart RESTORE SYSTEM for a data sharing group, the member on which the restart is issued must be the same member on which the original RESTORE SYSTEM was issued.

Related tasks:

"Restarting an online utility" on page 52

Effects of running RESTORE SYSTEM

The effects of running the RESTORE SYSTEM utility vary depending on your situation.

Recovering table spaces defined with NOT LOGGED attribute

If RESTORE SYSTEM utility determines that a table space defined with the NOT LOGGED attribute was updated after the point at which the system-level copy was taken, the table space or partition is marked RECOVER-pending.

Cases when indexes are placed in REBUILD-pending status

When you use the RESTORE SYSTEM utility to recover indexes, an index might be left in REBUILD-pending status. In these rare cases, you must rebuild the index by running the REBUILD INDEX utility.

Indexes are left in REBUILD-pending status, if on the DB2 subsystem that is being recovered:

- Some indexes have gone through the two-pass group buffer pool recovery pending (GRECP) or logical page list (LPL) recovery earlier
- Or the indexes are still in GRECP or LPL status, and the compensation log records are written before the physical undo logs

After running RESTORE SYSTEM

Certain activities might be required after you run the RESTORE SYSTEM utility, depending on your situation.

Complete the following steps after running RESTORE SYSTEM:

1. Stop and start each DB2 subsystem or member to remove it from access maintenance mode.
2. Use the DISPLAY UTIL command to see if any utilities are running. If other utilities are running, use the TERM UTIL command to end them.
3. Use the RECOVER utility to recover all objects in RECOVER-pending (RECP) or REBUILD-pending (RBDP) status, or use the REBUILD INDEX utility to rebuild objects. If a CREATE TABLESPACE, CREATE INDEX, or data set extension has failed, you can also recover or rebuild any objects in the logical page list (LPL).

Sample RESTORE SYSTEM control statements

Use the sample control statements as models for developing your own RESTORE SYSTEM utility control statements.

The RESTORE SYSTEM utility uses data that is copied by the BACKUP SYSTEM utility.

Example 1: Recovering a backup system

The following control statement specifies that RESTORE SYSTEM is to recover a DB2 subsystem or a data sharing group to a previous point in time by restoring volume copies and applying any outstanding log changes.

```
//STEP1    EXEC DSNUPROC,TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
  RESTORE SYSTEM
/*
```

Example 2: Recovering a backup system after the database volumes have already been restored

The LOGONLY keyword in the following control statement indicates that RESTORE SYSTEM is to apply any outstanding log changes to the database. The utility is not to restore the volume copies. In this example, the database volumes were restored outside of DB2. RESTORE SYSTEM applies log changes; it never restores the log copy pool.

```
//STEP1    EXEC DSNUPROC,TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
  RESTORE SYSTEM LOGONLY
/*
```

Example 3: Recovering a dump on tape of the database copy pool

The following control statement specifies that the RESTORE SYSTEM utility is to consider for restore only dumps on tape of the database copy pool. During the restore, the utility dynamically allocates a maximum of four tape units.

```
//SYSOPRB JOB (ACCOUNT),'NAME',CLASS=K
//UTIL EXEC DSNUPROC,SYSTEM=V91A,UID='TEMB',UTPROC=''
//*
//*
//DSNUPROC.SYSUT1 DD DSN=SYSOPR.SYSUT1,
//     DISP=(MOD,DELETE,CATLG),
//     SPACE=(16384,(20,20),,,ROUND),
//     UNIT=SYSDA
//DSNUPROC.SYSIN    DD  *
    RESTORE SYSTEM FROMDUMP TAPEUNITS 4
//
```

Example 4: Recovering a backup system after the database volumes have already been restored and VCAT aliases renamed

The LOGONLY keyword in the following control statement indicates that RESTORE SYSTEM is to apply any outstanding log changes to the database. The utility is not to restore the volume copies. In this example, the database volumes

were restored outside of DB2. RESTORE SYSTEM applies log changes; it never restores the log copy pool. The SWITCH VCAT SYSVALUEDDN(SYSVALUE) keywords indicate that the SYSVALUE DD name data set contains a list of pairs of integrated catalog facility (ICF) (VCAT) aliases. The first (VCAT) alias is the name when the backup was created and the second (VCAT) alias is the name after any renaming is complete. The (VCAT) alias DSNC000 is specified as both the first and second alias since it was not renamed and might be encountered in the log.

```
//STEP1    EXEC DSNUPROC,TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
  RESTORE SYSTEM LOGONLY SWITCH VCAT SYSVALUEDDN(SYSVALUE)
/*
//SYSVALUE  DD *
VCAT1,VCAT2
VCAT5,Z1234567
DSNC000,DSNC000
/*
```

Related concepts:

Point-in-time recovery with system-level backups (DB2 Administration Guide)

Related reference:

"Syntax and options of the RESTORE SYSTEM control statement" on page 728

Chapter 9, "BACKUP SYSTEM," on page 59

Chapter 33. RUNSTATS

The RUNSTATS online utility gathers summary information about the characteristics of data in table spaces, indexes, and partitions. DB2 records these statistics in the DB2 catalog and uses them to select access paths to data during the bind process.

You can use these statistics to evaluate the database design and determine when table spaces or indexes must be reorganized. To obtain the updated statistics, you can query the catalog tables.

The two formats for the RUNSTATS utility are RUNSTATS TABLESPACE and RUNSTATS INDEX. RUNSTATS TABLESPACE gathers statistics on a table space and, optionally, on tables, indexes or columns; RUNSTATS INDEX gathers statistics only on indexes. RUNSTATS does not collect statistics for clone tables or index spaces.

RUNSTATS can collect statistics on any single column or set of columns. RUNSTATS collects the following two types of distribution statistics:

Frequency
The percentage of rows in the table that contain a value for a column or combination of values for a set of columns.

Cardinality
The number of distinct values in the column or set of columns.

When you run RUNSTATS TABLESPACE, you can use the COLGROUP option to collect frequency and cardinality statistics on any column group. You can also collect frequency and cardinality statistics on any single column. When you run RUNSTATS INDEX, you can collect frequency statistics on the leading column of an index and multi-column frequency and cardinality statistics on the leading concatenated columns of an index.

When you run RUNSTATS TABLESPACE, you can use the HISTOGRAM option, with the COLGROUP option, to indicate that histogram statistics are to be gathered for the specified group of columns. RUNSTATS TABLESPACE does not collect histogram statistics for LOB table spaces or XML table spaces. When you run RUNSTATS INDEX, histogram statistics can only be collected on the prefix columns with the same order. Key columns with a mixed order are not allowed for histogram statistics. RUNSTATS INDEX does not collect histogram statistics for XML node ID indexes or XML indexes.

Restriction: You cannot run RUNSTATS on directory objects.

Output

RUNSTATS updates the DB2 catalog with table space or index space statistics, prints a report, or both.

Important: Use care when issuing SQL statements or using tools to update statistics values in catalog tables. If such updates introduce invalid data, unpredictable results can occur, including abends for RUNSTATS and other

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utilities. If such problems occur, you can run the RUNSTATS utility and collect statistics at the table space level to resolve the problems, in most cases.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- STATS privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on the implicitly created database or DSNDB04 is required.
- System DBADM authority
- SQLADM authority
- SYSCTRL or SYSADM authority

An ID with installation SYSOPR authority can also execute the RUNSTATS utility, but only on a table space in the DSNDB06 database.

To use RUNSTATS with the REPORT YES option, you must have the SELECT privilege on the reported tables. RUNSTATS does not report values from tables that the user is not authorized to see.

To gather statistics on a LOB table space, you must have SYSADM or DBADM authority for the LOB table space.

Execution phases of RUNSTATS

The RUNSTATS utility operates in the following phases:

Phase Description

UTILINIT
Performs initialization

RUNSTATS
Scans table space or index and updates catalog.

If you specify COLGROUP, RUNSTATS also performs a subtask that sorts one or more column group's data. If you specify FREQVAL with COLGROUP or are collecting frequency statistics for data-partitioned secondary indexes, RUNSTATS also performs a subtask that sorts the partition-level frequency data.

UTILTERM
Performs cleanup

Related concepts:

Statistics profiles (DB2 Performance)

Related tasks:

Maintaining statistics in the catalog (DB2 Performance)

Automating statistics maintenance (DB2 Performance)

Invalidating statements in the dynamic statement cache (DB2 Performance)

Related reference:

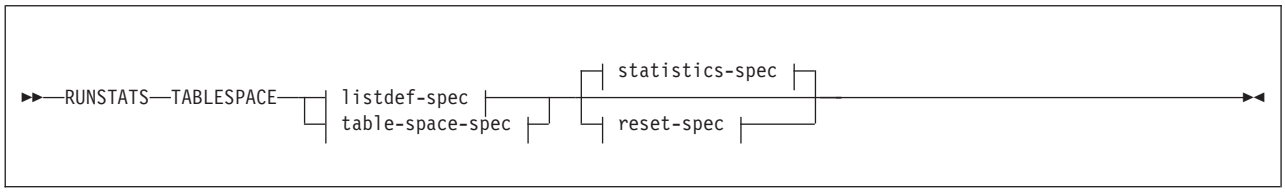
Case study: Stored procedure that runs RUNSTATS in parallel: Through the CALL and Beyond)

Syntax and options of the RUNSTATS control statement

The RUNSTATS utility control statement, with its multiple options, defines the function that the utility job performs.

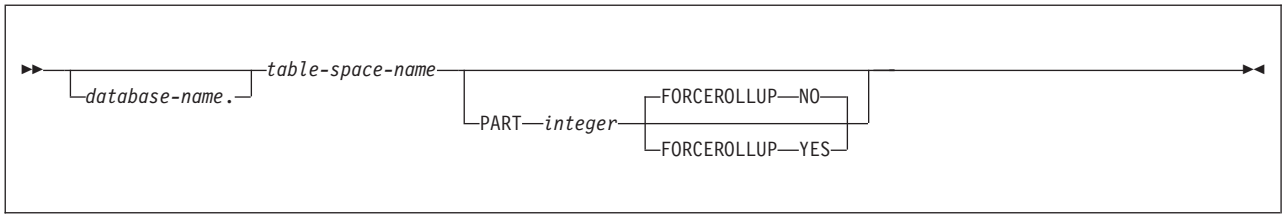
You can create a control statement with the ISPF/PDF edit function. After you create it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

RUNSTATS TABLESPACE syntax diagram

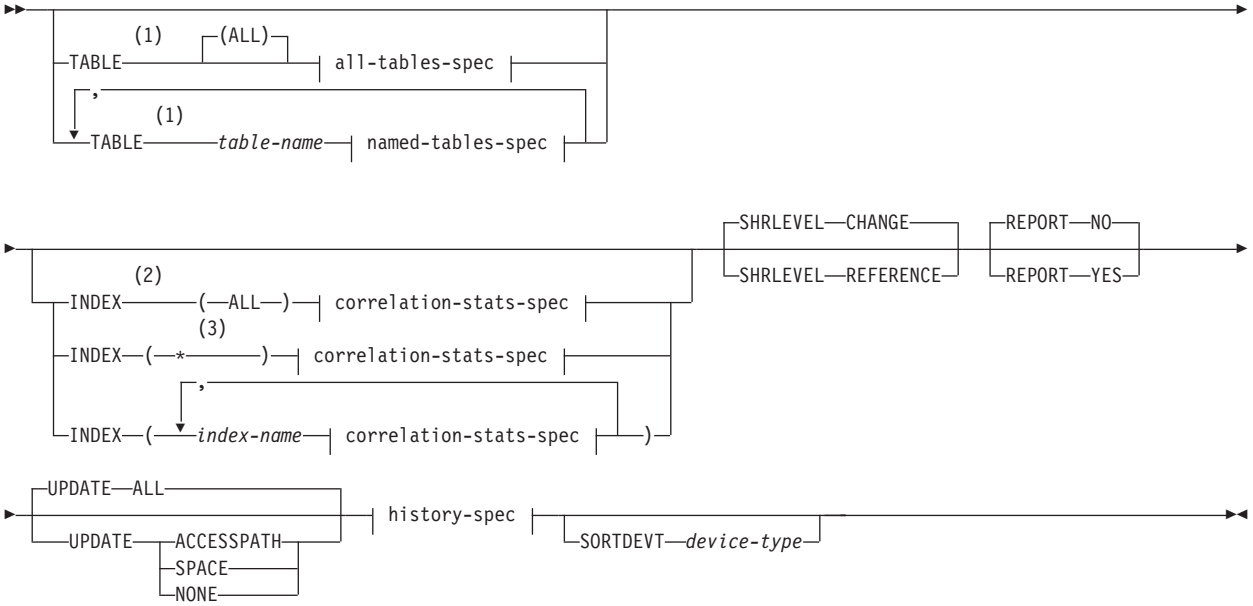


listdef-spec

table-space-spec



statistics-spec



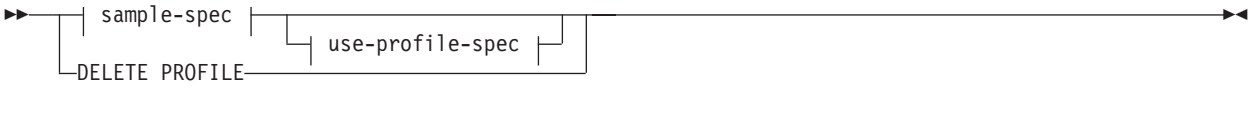
Notes:

1 The TABLE keyword is not valid for a LOB table space.

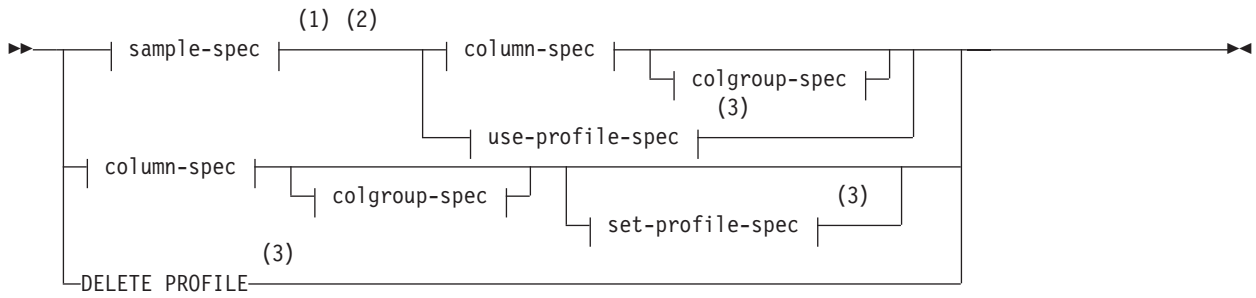
2 You cannot specify INDEX if either USE PROFILE or DELETE PROFILE option is also specified.

3 INDEX(*) is an internal representation of INDEX(ALL) that DB2 uses only in the context of RUNSTATS profiles, and is not valid when specified in any RUNSTATS control statement. When you specify the INDEX(ALL) option in a RUNSTATS control statement that creates a profile, DB2 uses INDEX(*) in the PROFILE_TEXT column of the SYSIBM.SYSTABLES_PROFILES catalog table. However, you must specify INDEX(*) instead of INDEX(ALL)) if you modify the profile by updating the value of the PROFILE_TEXT column directly.

all-tables-spec



named-tables-spec



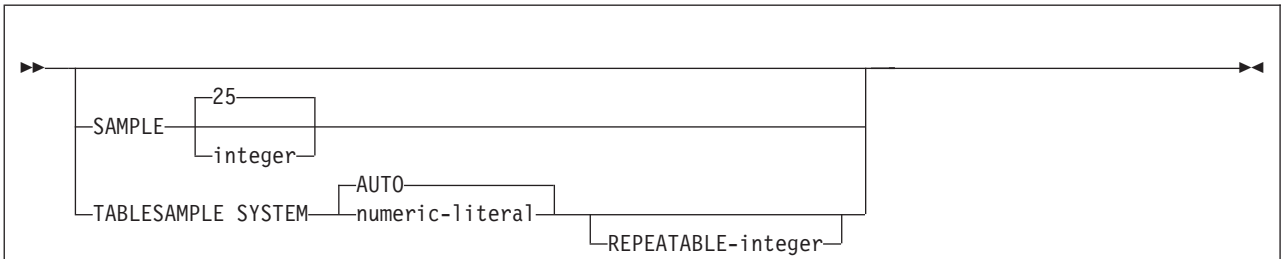
Notes:

1 The TABLESAMPLE keyword is only valid for single-table table spaces. Dropped tables are included in this count until REORG, COPY, and MODIFY RECOVERY are run.

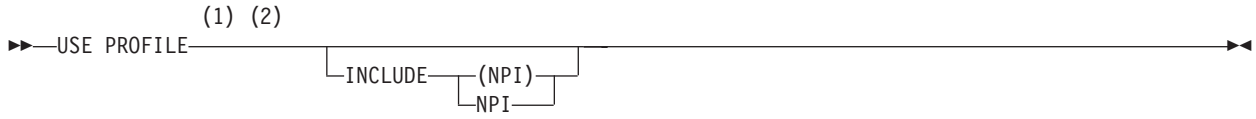
2 When using TABLESAMPLE to sample multi-table table spaces or table spaces that are segmented and not partitioned, page sampling is not done and execution continues. The TABLESAMPLE keyword is not valid for a LOB table space.

3 If one type of PROFILE function is specified on one TABLE clause the same type of PROFILE function must be specified on all TABLE clauses.

sample-spec



use-profile-spec

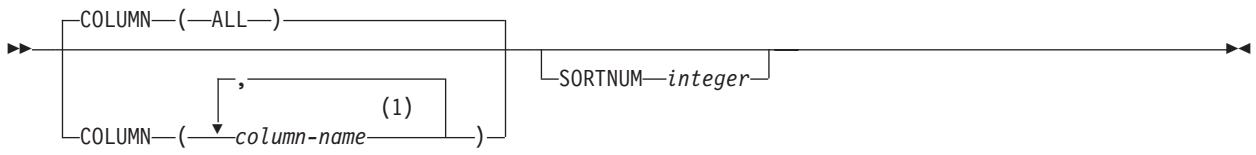


Notes:

1 When USE PROFILE is specified with the TABLE (ALL) keywords and no profile exists for a target table, TABLE ALL INDEX ALL is used for the profile specification.

2 When USE PROFILE is specified and no profile exists for a target table, COLUMN ALL INDEX ALL is used for the profile specification.

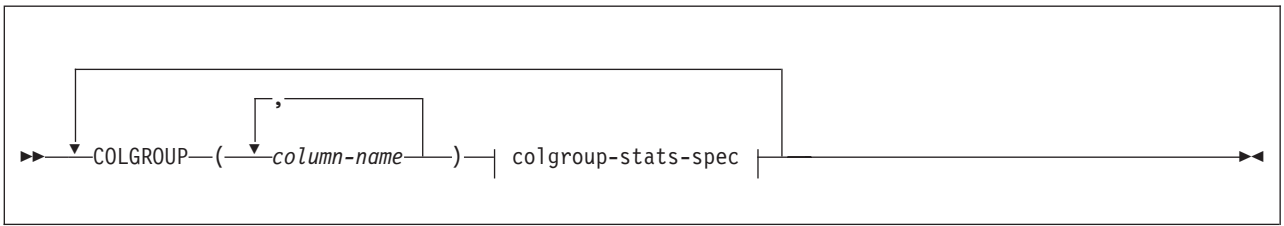
column-spec:



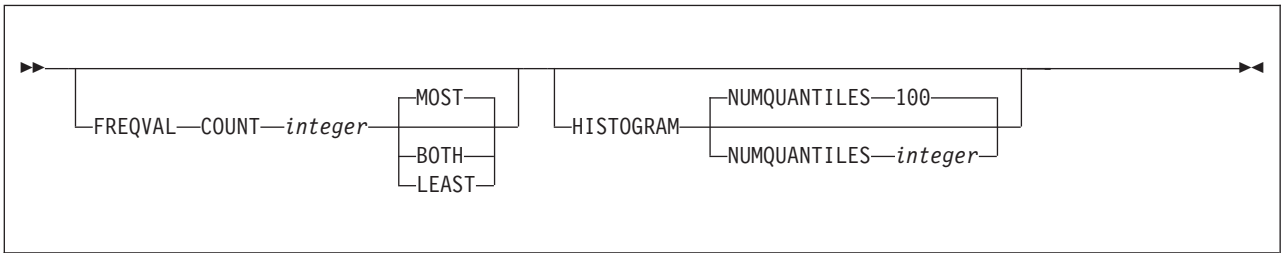
Notes:

1 The same column name must not be specified more than once. If all columns are listed in the COLUMN option, RUNSTAT will treat it as is, and does not replace it with the COLUMN(ALL) option. Users have to state explicitly if they want the COLUMN(ALL) option.

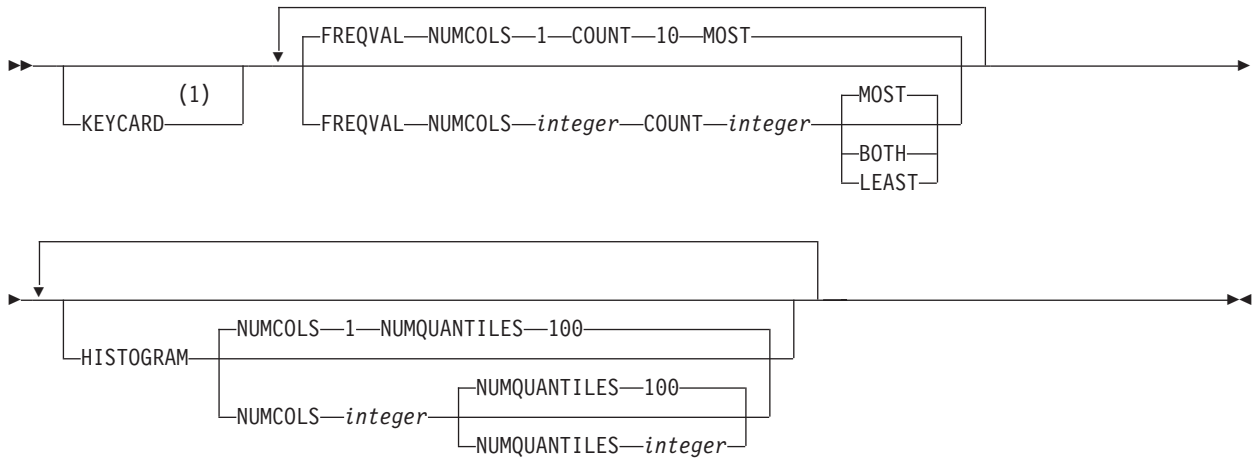
colgroup-spec:



colgroup-stats-spec:



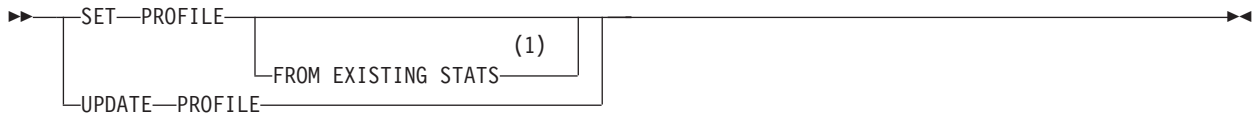
correlation-stats-spec:



Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the normal execution of the RUNSTATS INDEX utility and cannot be disabled.

set-profile-spec



Notes:

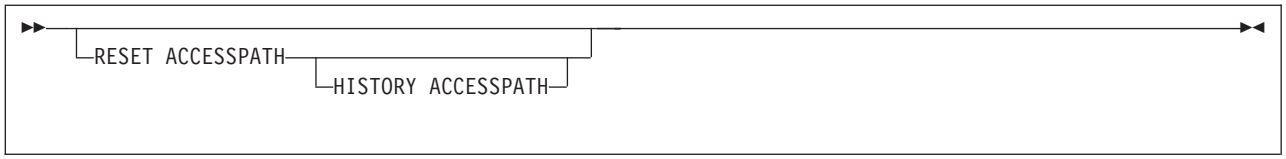
1 The FROM EXISTING STATS clause is not valid if a column-spec, colgroup-spec, or INDEX keyword has been specified

history-spec

Notes:

1 You can change the default HISTORY value by modifying the STATISTICS HISTORY subsystem parameter. By default, this value is NONE.

reset-spec



RUNSTATS TABLESPACE option descriptions

TABLESPACE *database-name.table-space-name*
Specifies the table space (and, optionally, the database to which it belongs) on which table space and table statistics are to be gathered. This keyword must not identify a table space in DSNDB01 or work file databases, which consist of DSNDB07 objects and user-defined work file objects.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. You can specify one LIST keyword for each RUNSTATS control statement. When you specify this keyword with RUNSTATS TABLESPACE, the list must contain only table spaces. Do not specify LIST with keywords from the TABLE...(*table-name*) specification. Instead, specify LIST with TABLE (ALL). Likewise, do not specify LIST with keywords from the INDEX...(*index-name*) specification. You cannot specify index names with a list. Use INDEX(ALL) instead.

If you specify LIST, you cannot specify the PART option. Instead, use the PARTLEVEL option on the LISTDEF statement. The TABLESPACE keyword is required to validate the contents of the list. RUNSTATS TABLESPACE is invoked once for each item in the list.

The partitions or partition ranges can be specified in a list.

database-name
Identifies the name of the database to which the table space belongs.

The default value is **DSNDB04**.

table-space-name
Identifies the name of the table space on which statistics are to be gathered.

If the table space that is specified by the TABLESPACE keyword is a LOB table space, you can specify only the following additional keywords: SHRLEVEL REFERENCE or CHANGE, REPORT YES or NO, and UPDATE ALL or NONE.

PART *integer*
Identifies a table space partition on which statistics are to be collected.

integer is the physical partition number. It must be in the range from 1 to the number of partitions that are defined for the table space. The maximum is 4096.

You cannot specify PART with LIST.

TABLE
Specifies the table on which column statistics are to be gathered. All tables must belong to the table space that is specified in the TABLESPACE option.

You cannot specify the TABLE option for a LOB table space. However, you can specify the TABLE option with the LIST option, even if the specified list includes LOB table spaces. In this case, the TABLE keyword applies to only the non-LOB table spaces and is ignored for the LOB table spaces.

(ALL)
Specifies that column statistics are to be gathered on all columns of all tables in the table space. The parentheses around ALL are optional.

The TABLE option value cannot specify a LOB table. However, if TABLE(ALL) is specified, and one or more of the tables in the table space have a LOB column, no error is issued for the LOB tables. RUNSTATS gathers table and column statistics only for the non-LOB tables.

(*table-name***)**
Specifies the tables on which column statistics are to be gathered. If you omit the qualifier, RUNSTATS uses the user identifier for the utility job as the qualifier. Enclose the table name in quotation marks if the name contains a blank.

If you specify more than one table, you must repeat the TABLE option. Multiple TABLE options must be specified entirely before or after any INDEX keyword is specified. For example, the INDEX keyword cannot be specified between any two TABLE keywords.

SAMPLE *integer*
Indicates the percentage of rows that RUNSTATS is to sample when collecting statistics on non-leading-indexed columns of an index or non-indexed columns. You can specify any value from 1 through 100.

The default value is **25**.

When a low SAMPLE value is specified, inaccuracies in sampling can result in inaccurate statistics and thus bad access paths. The smaller the sample, the more potential for inaccuracy, which can affect access paths.

You cannot specify SAMPLE for LOB table spaces.

USE PROFILE
Specifies a stored statistics profile that is used to gather statistics for a table. The statistics profile is created by using the SET PROFILE option and is updated by using the UPDATE PROFILE option.

The column, column group, and index specifications are not allowed as part of the control statement, but are used when stored in the statistics profile.

If no profile exists for the specified table, default statistics are collected:

- When a table name is not specified, TABLE ALL INDEX ALL is used for the profile specification.
- When a table name is specified, COLUMN ALL INDEX ALL is used for the profile specification.

INCLUDE NPI or INCLUDE (NPI)
Specifies that statistics are to be collected on the non-partitioned indexes that listed in the profile for the table. The INCLUDE NPI clause is not valid if the PART keyword is not specified at the RUNSTATS TABLESPACE level. You must specify the INCLUDE and NPI keywords together. The parentheses around NPI are optional.

DELETE PROFILE
Specifies an existing RUNSTATS profile that is to be deleted from the SYSIBM.SYSTABLES_PROFILES catalog table.

Column, column group, and index specifications are not allowed as part of the control statement when the DELETE PROFILE option is used. No statistics are collected when you specify this option in the RUNSTATS control statement.

TABLESAMPLE SYSTEM

Allows RUNSTATS to collect statistics on a sample of the data pages from the table. System sampling considers each page individually, including that page with probability P/100 (where P is the value of numeric-literal) and excluding it with probability 1-P/100. Unless the optional REPEATABLE clause is specified, each execution of RUNSTATS usually yields a different such sample of the table. The size of the sample is controlled by the integer parameter in parentheses, representing an approximate percentage P of the table to be returned. Only a percentage of the data pages as specified through the numeric-literal parameter is retrieved and used for the statistics collection. Only valid on single-table table spaces.

The TABLESAMPLE keyword is not valid for a LOB table space.

When RUNSTATS TABLESPACE TABLE is run on a multi-table table space or a table space that is segmented and not partitioned, the TABLESAMPLE keyword is not used. Instead, all pages are scanned to collect statistics.

numeric-literal

Specifies the size of the sample to be obtained, as a percentage P. This value must be a positive number that is less than or equal to 100 and greater than 0. For example, a value of 0.01 represents one one-hundredth of a percent, such that 1 row in 10,000 would be sampled, on average. A value greater than 100, zero, or a value less than zero is treated by DB2 as an error. The smallest allowable positive number for this option is 0.01 percent.

Depending on table space size and sampling rate that is used, it is possible that a partition is not included in the sample. In this case, RUNSTATS does not collect statistics for this partition, and might report warnings or errors for aggregate statistics.

When *numeric-literal* is specified, and real-time statistics are not available, DB2 issues message DSNU3343I.

Related information:

DSNU3343I (DB2 Messages)

AUTO

When "AUTO" is specified, RUNSTATS determines a sampling rate based on the size of the table when RUNSTATS runs. The larger the table the smaller the sampling rate. The threshold for sampling is when the table has more than 500,000 rows; otherwise all pages are read. The same threshold is applicable for TABLESPACE sampling with PART option specified. The number of rows is obtained from the real-time statistics report.

When AUTO is specified, and real-time statistics are not available, RUNSTATS sets the sampling rate to 100.

REPEATABLE integer

Adding the REPEATABLE clause to the TABLESAMPLE clause ensures that repeated executions of RUNSTATS return the same sample. The integer parameter is a non-negative integer that represents the seed to be used in sampling. Passing a negative seed results in an error (DSNU048I). The sample set might still vary between repeatable RUNSTATS invocations. Variations can occur if activity against the table or statistical view results in changes to the table or statistical view data since the last time TABLESAMPLE REPEATABLE was run.

SET PROFILE
Specifies that RUNSTATS is to generate a RUNSTATS profile for the specified table from the options that are specified in the current RUNSTATS invocation. RUNSTATS stores the profile in the SYSIBM.SYSTABLES_PROFILES catalog table. No statistics are collected when you specify this option in the RUNSTATS control statement. For more information about the options that you can specify in a profile, and the syntax for specifying the options, see: "The statistics profile syntax" on page 758.

FROM EXISTING STATS
Allows RUNSTATS to generate a RUNSTATS profile with options that are based on analysis of the statistics that currently exist for the specified table. This option can be specified only with the SET PROFILE option.

UPDATE PROFILE
Allows RUNSTATS to update an existing statistics profile in the SYSIBM.SYSTABLES_PROFILES catalog table with the options specified in the current RUNSTATS invocation. No statistics are collected when you specify this option in the RUNSTATS control statement. If the column or COLGROUP specification already exists in the profile, the new specification replaces the existing one.

COLUMN
Specifies columns on which column statistics are to be gathered.

You can specify this option only if you specify a particular table on which statistics are to be gathered. (Use the TABLE (*table-name*) option to specify a particular table.) If you specify particular tables and do not specify the COLUMN option, RUNSTATS uses the default, COLUMN(ALL). If you do not specify a particular table with the TABLE option, you cannot specify the COLUMN option; however, in this case, COLUMN(ALL) is assumed.

(ALL)
Specifies that statistics are to be gathered on all columns in the table.

The COLUMN (ALL) option is not allowed for LOB table spaces.

(*column-name***, ...)**
Specifies the columns on which statistics are to be gathered. You can specify a list of column names. If you specify more than one column, separate each name with a comma.

The more columns that you specify, the longer the job takes to complete.

COLGROUP (*column-name***, ...)**
Indicates that the specified set of columns are to be treated as a group. This option enables RUNSTATS to collect a cardinality value on the specified column group. RUNSTATS TABLESPACE ignores COLGROUP when processing XML table spaces and indexes.

When you specify the COLGROUP keyword, RUNSTATS collects correlation statistics for the specified column group. If you want RUNSTATS to also collect distribution statistics, specify the FREQVAL option with COLGROUP.

(*column-name*, ...) specifies the names of the columns that are part of the column group.

To specify more than one column group, repeat the COLGROUP option.

Restriction: The length of a COLGROUP value cannot exceed the maximum length of the COLVALUE column in the SYSIBM.SYSCOLDIST catalog table.

Restriction: A RUNSTATS control statement can contain a maximum of 255 COLGROUP specifications.

FREQVAL
Indicates, when specified with the COLGROUP option, that frequency statistics are also to be gathered for the specified group of columns. (COLGROUP indicates that cardinality statistics are to be gathered.) One group of statistics is gathered for each column. You must specify COUNT *integer* with COLGROUP FREQVAL. RUNSTATS TABLESPACE ignores FREQVAL MOST, FREQVAL LEAST, or FREQVAL BOTH when it processes XML table spaces and indexes.

COUNT *integer*
Specifies how many frequently occurring values are collected from the specified column group. You must specify a value for *integer*. No default value is assumed.

It is best to specify a COUNT value that is not greater than the value of COLCARDF minus one, for the column group. For most situations, 10 is usually a reasonable value. Greater COUNT values might be needed to detect skewed data, especially in high cardinality cases. However, avoid values greater than 100 in most cases. Specifying a value of 1000 or more can increase the prepare time for some SQL statements.

MOST
Indicates that the utility collects the most frequently occurring values for the specified set of columns when COLGROUP is specified. For example, `FREQVAL COUNT 10 MOST` means that the 10 most frequently occurring values are collected.

BOTH
Indicates that the utility collects the most and the least frequently occurring values for the specified set of columns when COLGROUP is specified. If COUNT is *n*, the utility collects the *n* least frequently occurring values and the *n* most frequently occurring values.

LEAST
Indicates that the utility collects the least frequently occurring values for the specified set of columns when COLGROUP is specified.

HISTOGRAM
Indicates, when specified with the COLGROUP (see *colgroup-stats-spec*) option of RUNSTATS TABLESPACE, that histogram statistics are to be gathered for the specified group of columns. RUNSTATS TABLESPACE ignores HISTOGRAM when processing XML table spaces and indexes.

NUMQUANTILES *integer*

Indicates how many quantiles that the utility is to collect. The *integer* value must be greater than or equal to one. The number of quantiles that you specify should never exceed the total number of distinct values in the column or the column group. The maximum number of quantiles that is allowed is 100.

When the NUMQUANTILES keyword is omitted, NUMQUANTILES takes a default value of 100. Based on the number of records in the table, the number of quantiles is readjusted down to an optimal number.

INDEX
Specifies indexes on which statistics are to be gathered. RUNSTATS gathers column statistics for the first column of the index, and depending on the options that you specify, possibly additional index columns. All the indexes

must be associated with the same table space, which must be the table space that is specified in the TABLESPACE option.

INDEX can be used on auxiliary tables to gather statistics on an index.

(ALL)
Specifies that column statistics are to be gathered for all indexes that are defined on tables that are contained in the table space.

(*)
Specifies that statistics are to be gathered for all indexes that are defined on the specified table.

(*index-name***, ...)**
Specifies the indexes for which statistics are to be gathered. You can specify a list of index names. If you specify more than one index, separate each name with a comma. Enclose the index name in quotation marks if the name contains a blank.

PART *integer*
Identifies an index partition on which statistics are to be collected.

integer is the number of the partition.

KEYCARD
The KEYCARD option is deprecated in the RUNSTATS TABLESPACE control statement and no longer needs to be specified to collect statistics on the values in the key columns of an index if INDEX is specified.

The RUNSTATS utility automatically collects all of the distinct values in all of the 1 to *n* intermediate key column combinations for the specified indexes, where *n* is the number of columns in the index. For example, suppose that you have an index defined on three columns: A, B, and C. RUNSTATS collects cardinality statistics for column A, column set A and B, and column set A, B, and C. With the deprecation of KEYCARD, this functionality cannot be disabled.

The RUNSTATS utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when INDEX is specified.

FREQVAL
Controls, when specified with the INDEX option, the collection of frequent-value statistics. If you specify FREQVAL with INDEX, this keyword must be followed by the NUMCOLS and COUNT keywords.

NUMCOLS *integer*
Indicates the number of columns in the index for which RUNSTATS is to collect frequently occurring values. *integer* can be a number between 1 and the number of indexed columns. If you specify a number greater than the number of indexed columns, RUNSTATS uses the number of columns in the index.

For example, suppose that you have an index defined on three columns: A, B, and C. If you specify NUMCOLS 1, DB2 collects frequently occurring values for column A. If you specify NUMCOLS 2, DB2 collects frequently occurring values for the column set A and B. If you specify NUMCOLS 3, DB2 collects frequently occurring values for the column set A, B, and C.

The default value is **1**, which means that RUNSTATS is to collect frequently occurring values on the first key column of the index.

COUNT *integer*
Indicates the number of frequently occurring values that are to be collected from the specified key columns. For example, specifying 15 means that RUNSTATS is to collect 15 frequently occurring values from the specified key columns.

The default value is **10**.

HISTOGRAM
Indicates, when specified with the INDEX option (correlation-stats-spec) for RUNSTATS TABLE SPACE, that histogram statistics are to be gathered for the specified key columns. Histogram statistics can be collected only on the prefix columns with the same order. Key columns for histogram statistics with a mixed order are not allowed.

When RUNSTATS collects histogram statistics for partition table spaces, it aggregates them into SYSCOLDIST.

NUMQUANTILES *integer*

Indicates how many quantiles that the utility is to collect. The *integer* value must be greater than or equal to one. The number of quantiles that you specify should never exceed the total number of distinct values in the key columns specified. The maximum number of quantiles that is allowed is 100.

When the NUMQUANTILES keyword is omitted, NUMQUANTILES takes a default value of 100. Based on the number of keys in the index, the number of quantiles is readjusted down to an optimal number.

SHRLEVEL
Indicates whether other programs that access the table space while RUNSTATS is running must use read-only access or can change the table space.

CHANGE
Allows other programs to change the table space or index. With SHRLEVEL CHANGE, RUNSTATS might collect statistics on uncommitted data.

REFERENCE
Allows only read-only access by other programs.

REPORT
Specifies whether RUNSTATS is to generate a set of messages that report the collected statistics.

NO Indicates that RUNSTATS is not to generate the set of messages.

YES
Indicates that the set of messages is to be sent as output to SYSPRINT. The messages that RUNSTATS generates depend on the combination of keywords in the utility control statement. However, these messages do not depend on the value of the UPDATE option. REPORT YES always generates a report of space and access path statistics.

UPDATE
Indicates which collected statistics are to be inserted into the catalog tables.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that DB2 is to update the catalog with only those statistics that are used for access path selection.

SPACE
Indicates that DB2 is to update the catalog with only space-related statistics.

NONE
Indicates that no catalog tables are to be updated with the collected statistics.

Running the RUNSTATS always invalidates the dynamic cache. However, when you specify UPDATE NONE REPORT NO, RUNSTATS invalidates statements in the dynamic statement cache without collecting statistics, updating catalogs tables, or generating reports.

HISTORY
Indicates which statistics are to be recorded in the catalog history tables. The value that you specify for HISTORY does not depend on the value that you specify for UPDATE.

The default is the value of the STATISTICS HISTORY subsystem parameter on the DSNTIPO installation panel. By default, this parameter value is NONE.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that DB2 is to update the catalog history tables with only those statistics that are used for access path selection.

SPACE
Indicates that DB2 is to update the catalog history tables with only space-related statistics.

NONE
Indicates that no catalog history tables are to be updated with the collected statistics.

SORTDEVT
Specifies the device type that the sort program uses to dynamically allocate the sort work data sets that are required.

device-type
Specifies any device type that is acceptable for the DYNALLOC parameter of the SORT or OPTIONS option of the external sort program.

If all of the following conditions are true, SORTDEVT defaults to SYSALLDA and the temporary data sets are dynamically allocated:

- You omit SORTDEVT.
- A sort is required.
- You did not provide the DD statements that the sort program requires for the temporary data sets

If you specify SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

SORTNUM
Specifies the number of required sort work data sets that the sort program is to allocate.

integer is the number of temporary data sets that can range from 2 to 255.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, suppose RUNSTATS is being run on three indexes, SORTKEYS is specified, no constraints limit parallelism, and SORTNUM is specified as 8. In this case, a total of 24 sort work data sets are allocated for a job.

Each sort work data set uses both above the line and below the line virtual storage. Therefore, if you specify too high a value for SORTNUM, the utility might decrease the degree of parallelism due to virtual storage constraints, and possibly decrease the degree down to one, which means that no parallelism is used.

Important: The SORTNUM keyword is not considered if subsystem parameter UTSORTAL is set to YES and IGNSORTN is set to YES.

FORCEROLLUP

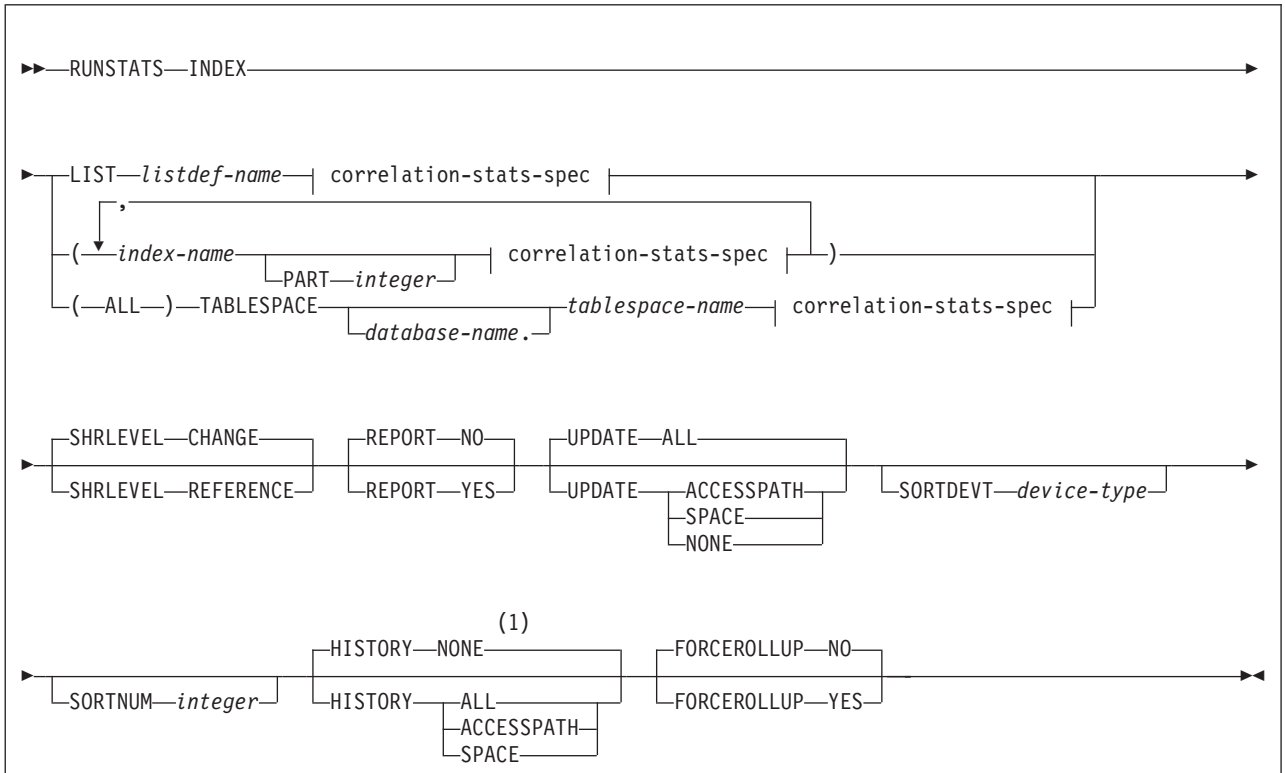
Specifies whether aggregation or roll up of statistics is to occur even if statistics were not gathered on some partitions. This option enables the optimizer to select the best access path.

YES
Indicates that forced aggregation or rollup processing is to be done, even though some partitions might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all partitions.

If the value for STATISTICS ROLLUP on panel DSNTIPO is NO and data is not available for all partitions, DB2 issues message DSNU623I.

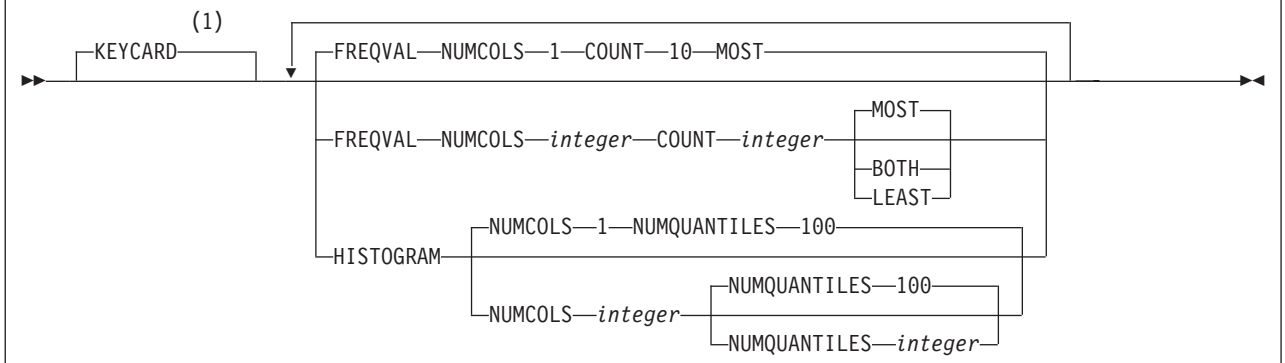
RUNSTATS INDEX syntax diagram



Notes:

1 You can change the default HISTORY value by modifying the STATISTICS HISTORY subsystem parameter. By default, this value is NONE.

correlation-stats-spec:



Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the normal execution of the RUNSTATS INDEX utility and cannot be disabled.

RUNSTATS INDEX option descriptions

INDEX
Specifies the indexes on which statistics are to be gathered. Column statistics are gathered on the first column of the index. All of the indexes must be associated with the **same** table space.

LIST *listdef-name*
Specifies the name of a previously defined LISTDEF list name. You can specify one LIST keyword for each RUNSTATS control statement. When you specify LIST with RUNSTATS INDEX, the list must contain only index spaces. Do not specify LIST with keywords from the INDEX...(*index-name*) specification; except for the correlation-stats-spec.

RUNSTATS groups indexes by their related table space. RUNSTATS INDEX is invoked once per table space. The INDEX keyword is required to validate the contents of the LIST.

(*index-name***, ...)**
Specifies the indexes on which statistics are to be gathered. You can specify a list of index names. If you specify more than one index, separate each name with a comma. Enclose the index name in quotation marks if the name contains a blank.

PART *integer*
Identifies the index partition on which statistics are to be collected.

integer is the number of the partition.

(ALL)
Specifies that statistics are to be gathered on all indexes that are defined on all tables in the specified table space.

TABLESPACE
Identifies the table space and, optionally, the database to which it belongs, for which index statistics are to be gathered.

database-name
The name of the database to which the table space belongs.

The default value is **DSNDB04**.

tablespace-name
The name of the table space for which index statistics are to be gathered.

KEYCARD
The KEYCARD option is deprecated in the RUNSTATS INDEX control statement and no longer needs to be specified to collect statistics on the values in the key columns of an index.

Except when processing XML NODEID or XML values indexes, the RUNSTATS utility automatically collects all of the distinct values in all of the 1 to *n* key column combinations for the specified indexes, where *n* is the number of columns in the index. For example, suppose that you have an index defined on three columns: A, B, and C. RUNSTATS collects cardinality statistics for column A, column set A and B, and column set A, B, and C. With the deprecation of KEYCARD, this functionality cannot be disabled.

The RUNSTATS utility tolerates the specification of the KEYCARD option. The utility does not issue any messages if the control statement includes or excludes the KEYCARD option when INDEX is specified.

FREQVAL
Controls, when specified with the INDEX option, the collection of frequent-value statistics. If you specify FREQVAL with INDEX, this keyword must be followed by the NUMCOLS and COUNT keywords. RUNSTATS INDEX ignores FREQVAL MOST/LEAST/BOTH when processing XML NODEID or XML values indexes.

NUMCOLS *integer*
Indicates the number of columns in the index for which RUNSTATS is to collect frequently occurring values. *integer* can be a number between 1 and the number of indexed columns. If you specify a number greater than the number of indexed columns, RUNSTATS uses the number of columns in the index.

For example, suppose that you have an index defined on three columns: A, B, and C. If you specify NUMCOLS 1, DB2 collects frequently occurring values for column A. If you specify NUMCOLS 2, DB2 collects frequently occurring values for the column set A and B. If you specify NUMCOLS 3, DB2 collects frequently occurring values for the column set A, B, and C.

The default value is **1**, which means that RUNSTATS is to collect frequently occurring values on the first key column of the index.

COUNT *integer*
Indicates the number of frequently occurring values that are to be collected from the specified key columns. For example, specifying 15 means that RUNSTATS is to collect 15 frequently occurring values from the specified key columns.

The **default** is **10**.

MOST
Indicates that the utility is to collect the most frequently occurring values for the specified set of key columns when FREQVAL NUMCOLS COUNT MOST keywords are specified.

LEAST
Indicates that the utility is to collect the least frequently occurring values for the specified set of key columns when FREQVAL NUMCOLS COUNT LEAST keywords are specified.

BOTH
Indicates that the utility is to collect the most and the least frequently occurring values for the specified set of key columns when FREQVAL NUMCOLS COUNT BOTH keywords are specified.

HISTOGRAM
Indicates, when specified with the INDEX option (see correlation-stats-spec) for RUNSTATS INDEX, that histogram statistics are to be gathered for the specified key columns. Histogram statistics can be collected only on the prefix columns with the same order. Key columns for histogram statistics with a mixed order are not allowed.

When RUNSTATS collects histogram statistics for partitioned indexes, it aggregates them into SYSCOLDIST. RUNSTATS INDEX ignores the HISTOGRAM keyword when processing XML NODEID or XML values indexes.

NUMQUANTILES *integer*
Indicates how many quantiles that the utility is to collect. The *integer* value must be greater than or equal to one. The number of quantiles that you

specify should never exceed the total number of distinct values in the specified key columns. The maximum number of quantiles is 100.

When the NUMQUANTILES keyword is omitted, NUMQUANTILES takes a default value of 100. Based on the number of keys in the index, the number of quantiles is readjusted down to an optimal number.

SHRLEVEL
Indicates whether other programs that access the table space while RUNSTATS is running must use read-only access or can change the table space.

CHANGE
Allows other programs to change the table space or index. With SHRLEVEL CHANGE, RUNSTATS might collect statistics on uncommitted data.

REFERENCE
Allows only read-only access by other programs.

REPORT
Specifies whether RUNSTATS is to generate a set of messages that report the collected statistics.

NO Indicates that RUNSTATS is not to generate the set of messages.

YES
Indicates that the set of messages is to be sent as output to SYSPRINT. The messages that RUNSTATS generates depend on the combination of keywords in the utility control statement. However, these messages do not depend on the value of the UPDATE option. REPORT YES always generates a report of space and access path statistics.

UPDATE
Indicates which collected statistics are to be inserted into the catalog tables.

ALL
Indicates that all collected statistics are to be updated in the catalog.

ACCESSPATH
Indicates that DB2 is to update the catalog with only those statistics that are used for access path selection.

SPACE
Indicates that DB2 is to update the catalog with only space-related statistics.

NONE
Indicates that no catalog tables are to be updated with the collected statistics.

Running RUNSTATS always invalidates the dynamic cache. However, when you specify UPDATE NONE REPORT NO, RUNSTATS invalidates statements in the dynamic statement cache without collecting statistics, updating catalogs tables, or generating reports.

SORTDEVT
Specifies the device type that the external sort program uses to dynamically allocate the sort work data sets that are required.

device-type
Specifies any disk device type that is acceptable for the DYNALLOC parameter of the SORT or OPTIONS option of the external sort program.

If all of the following conditions are true, SORTDEVT defaults to SYSALLDA and the temporary data sets are dynamically allocated:

- You omit SORTDEVT.
- A sort is required.
- You did not provide the DD statements that the sort program requires for the temporary data sets

If you specify SORTDEVT and omit SORTNUM, no value is passed to the sort program; the sort program uses its own default.

SORTNUM
Specifies the number of required sort work data sets that the sort program is to allocate.

integer is the number of temporary data sets that can range from 2 to 255.

You need at least two sort work data sets for each sort. The SORTNUM value applies to each sort invocation in the utility. For example, suppose that RUNSTATS is running on three indexes, SORTKEYS is specified, no constraints limit parallelism, and SORTNUM is specified as 8. In thise case, a total of 24 sort work data sets are allocated for a job.

Each sort work data set uses both above the line and below the line virtual storage. Therefore, if you specify too high a value for SORTNUM, the utility might decrease the degree of parallelism due to virtual storage constraints, and possibly decrease the degree down to one, which means that no parallelism is used.

HISTORY
Indicates which statistics are to be recorded in the catalog history tables. The value that you specify for HISTORY does not depend on the value that you specify for UPDATE.

The default is the value of the STATISTICS HISTORY subsystem parameter on the DSNTIPO installation panel. By default, this parameter value is NONE.

ALL
Indicates that all collected statistics are to be updated in the catalog history tables.

ACCESSPATH
Indicates that DB2 is to update the catalog history tables with only those statistics that are used for access path selection.

SPACE
Indicates that DB2 is to update the catalog history tables with only space-related statistics.

NONE
Indicates that no catalog history tables are to be updated with the collected statistics.

FORCEROLLUP
Specifies whether aggregation or rollup of statistics is to occur even if statistics were not gathered on some partitions. This option enables the optimizer to select the best access path.

YES
Indicates that forced aggregation or rollup processing is to be done, even though some partitions might not contain data.

NO Indicates that aggregation or rollup is to be done only if data is available for all partitions.

If the value for STATISTICS ROLLUP on panel DSNTIPO is NO and data is not available for all partitions, DB2 issues message DSNU623I.

RESET ACCESSPATH
Resets access path statistics for all tables in the specified table space and related indexes. Real-time statistics and space statistics in the catalog for the target objects are not reset. For a complete list of the statistics that are reset or deleted when you specify this option, see: "Resetting access path statistics" on page 774.

Important: You cannot recover previous values after the RUNSTATS utility is invoked with the RESET ACCESSPATH option, unless a statistics history is maintained. Specifying the HISTORY_ACCESSPATH option only records when the access path statistics were reset, and does not provide a method for recovering the previous values. For more information about how to maintain a statistics history, see "Collecting statistics history" on page 768.

Statements that refer to the objects for which statistics are reset are invalidated in the dynamic statement cache.

This option cannot be specified for LOB table spaces.

When this RESET ACCESSPATH is used, other keywords that specify the specific statistics to be collected within the table space cannot be specified.

HISTORY ACCESSPATH
Inserts rows into the following tables for each object for which the access path statistics are reset when the RESET ACCESSPATH option is specified:

- SYSIBM.SYSTABLES_HIST for tables.
- SYSIBM.SYSINDEXES_HIST for indexes.

Related tasks:

Automating statistics maintenance (DB2 Performance)

Related reference:

Chapter 19, "LISTDEF," on page 221

DB2 Sort

Related information:

DFSORT Application Programming Guide

The statistics profile syntax

The options of a statistics profile are stored within the PROFILE_TEXT column of the SYSTABLES_PROFILES catalog table. These options normally have the same meanings as they do when specified directly in a RUNSTATS utility control statement.

You can specify the following statistics collection options in a statistics profile:

- COLUMN
- COLGROUP
- FREQVAL
- COUNT
- MOST

- BOTH
- LEAST
- INDEX
- KEYCARD
- NUMCOLS
- COUNT
- MOST
- BOTH
- LEAST
- HISTOGRAM
- NUMQUANTILES

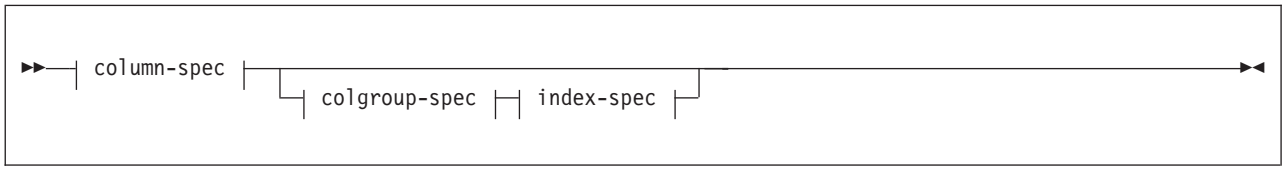
The profile contains the default values for any options that are not specified.

When you update an existing profile that contains a partitioned index, the PART keyword must be specified on all index specifications for that index, or omitted from the index specification for that index. Statistics profile processing enforces this requirement. Any profile modifications done through SQL statements must follow the same restriction, or error messages result when the profile is used.

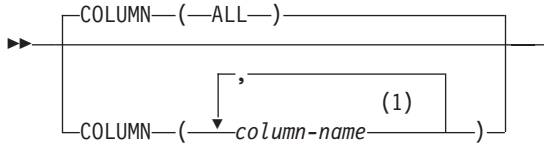
For a given partitioned index:

- Any new index specifications without the PART keyword replace all index specifications in the profile regardless of the PART keyword specification.
- Any new index specification with the PART keyword replaces only the existing index specification with the same PART specified, or a specification without the PART keyword.

The PROFILE functions cannot be executed when there are syntax errors in the statistics profile. Syntax errors can be corrected using RUNSTATS UPDATE PROFILE or SQL UPDATE, or by deleting the profile with RUNSTATS DELETE PROFILE or SQL DELETE.



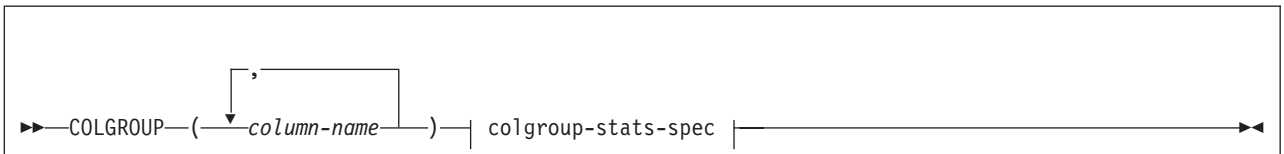
column-spec:



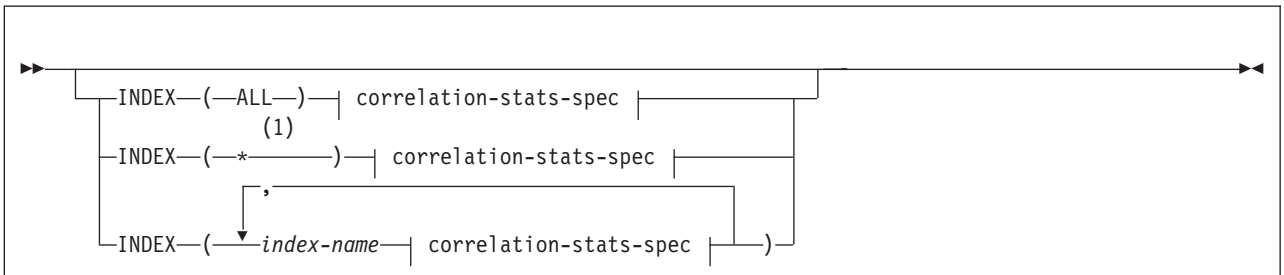
Notes:

1 The same column name must not be specified more than once. If all columns are listed in the COLUMN option, RUNSTATS treats it as-is, and does not replace the list with the COLUMN(ALL) option. You must specify the COLUMN(ALL) option explicitly.

colgroup-spec:



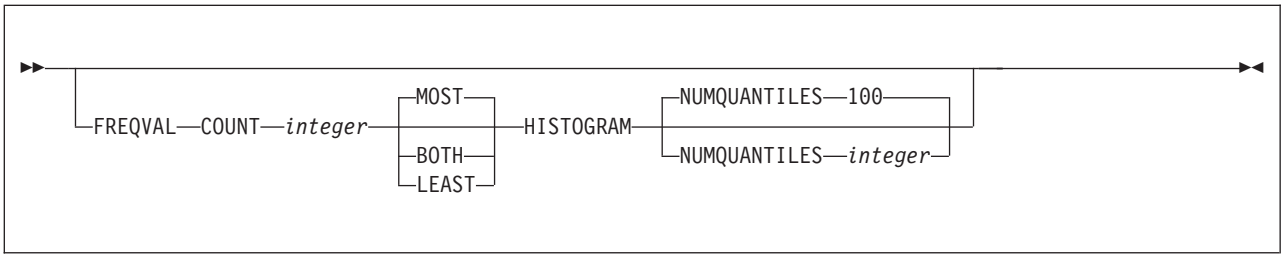
index-spec:



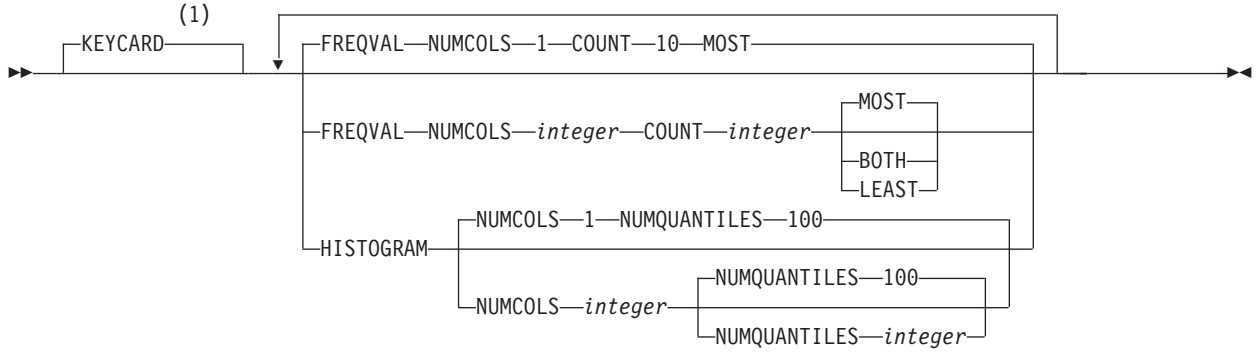
Notes:

1 INDEX(*) is an internal representation of INDEX(ALL) that DB2 uses only in the context of RUNSTATS profiles, and is not valid when specified in any RUNSTATS control statement. When you specify the INDEX(ALL) option in a RUNSTATS control statement that creates a profile, DB2 uses INDEX(*) in the PROFILE_TEXT column of the SYSIBM.SYSTABLES_PROFILES catalog table. However, you must specify INDEX(*) instead of INDEX(ALL)) if you modify the profile by updating the value of the PROFILE_TEXT column directly.

colgroup-stats-spec:



correlation-stats-spec:



Notes:

1 The KEYCARD option is deprecated. The KEYCARD functionality is now built into the normal execution of the RUNSTATS utility and cannot be disabled.

Related tasks:

- Automating statistics maintenance (DB2 Performance)
- Maintaining statistics in the catalog (DB2 Performance)
- Updating statistics profiles (DB2 Performance)
- Creating statistics profiles (DB2 Performance)

Before running RUNSTATS

Certain activities might be required before you run the RUNSTATS utility, depending on your situation.

Use caution when running RUNSTATS after any user has manually updated the statistic columns in the catalog. RUNSTATS replaces any values that the user changed.

Important: Use care when issuing SQL statements or using tools to update statistics values in catalog tables. If such updates introduce invalid data, unpredictable results can occur, including abends for RUNSTATS and other utilities. If such problems occur, you can run the RUNSTATS utility and collect statistics at the table space level to resolve the problems, in most cases.

If you plan to use another utility to load or reorganize the same data, consider collecting inline statistics with that utility to avoid the cost of running the RUNSTATS utility separately.

Restriction: RUNSTATS might not provide useful statistics on encrypted data.

Related tasks:

- Collecting statistics by using DB2 utilities (DB2 Performance)
- Modifying catalog statistics to influence access path selection (DB2 Performance)

Data sets that RUNSTATS uses

The RUNSTATS utility uses a number of data sets during its operation.

The following table lists the data sets that RUNSTATS uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 107. Data sets that RUNSTATS uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
RNPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when distribution statistics are collected for column groups.	No[1]
STPRIN01	A data set that contains messages from the sort program (usually, SYSOUT or DUMMY). This data set is used when frequency statistics are collected on data-partitioned secondary indexes, or when TABLESPACE TABLE COLGROUP FREQVAL is specified.	Yes[1,2,5]
Sort work data sets[6]	Temporary data sets for sort input and output when collecting statistics on at least one data-partitioned secondary index. This data set is used when the COLGROUP option is specified or the COLGROUP and FREQVAL options are specified. The DD names have the form ST01WK*nn*.	No[3,4]
Sort work data sets[6]	Temporary data sets for sort input and output when collecting distribution statistics for column groups. The DD names have the form STATWK01.	No[1,4]
Sort work data sets[6]	Temporary data sets for sort input and output when collecting frequency statistics. The DD names have the form SORTWK01 and ST02WK*nn*.	No[4]

Note:

1. Required when collecting distribution statistics for column groups.
2. STPRIN01 is required if statistics are being collected on at least one data-partitioned secondary index, but RUNSTATS dynamically allocates the STPRIN01 data set if UTPRINT is allocated to SYSOUT.
3. Required when collecting statistics on at least one data-partitioned secondary index.
4. If the DYNALLOC parm of the SORT program is not turned on, you need to allocate the data set. Otherwise, the sort program dynamically allocates the temporary data set.
5. Required when the COLGROUP with FREQVAL options are specified.
6. It is recommended that you use dynamic allocation by specifying SORTDEVT in the utility statement because dynamic allocation reduces the maintenance required of the utility job JCL.

The following objects are named in the utility control statement and do not require DD statements in the JCL:

Table space or index
Object that is to be scanned.

Calculating the size of the sort work data sets

Depending on the type of statistics that RUNSTATS collects, the utility uses the ST01WK*nn* data sets, the SORTWK01 data set, both types of data sets, or neither.

The ST01WK*nn* data sets are used when collecting statistics on at least one data-partitioned secondary index. To calculate the approximate size (in bytes) of the ST01WK*nn* data set, use the following formula:

2 ×(*maximum record length* × *numcols* × (*count* + 2) × number of indexes)

The variables in the preceding formula have the following values:

maximum record length
Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

numcols
Number of key columns to concatenate when you collect frequent values from the specified index.

count Number of frequent values that RUNSTATS is to collect.

The SORTWK01 data set is used when collecting distribution statistics. To calculate the approximate size (in bytes) of the SORTWK01 data set, use the following formula:

(longest_record_length + prefix) × sum from 1 to *N* ($\#colgroups_n$ × *#rows* - n)

The variables in the preceding formula have the following values:

N Number of tables for which distribution statistics are collected

$\#colgroups_n$
Number of column groups that are specified for the nth table

#rows Number of rows for the nth table

The ST02WK*nn* data sets are used when collecting frequency statistics on at least one COLGROUP. To calculate the approximate size (in bytes) of the ST02WK*nn* data set, use the following formula:

2 ×(*maximum record length* × (*count* + 2) × number of parts)

The variables in the preceding formula have the following values:

maximum record length
Maximum record length of the SYSCOLDISTSTATS record that is processed when collecting frequency statistics (You can obtain this value from the RECLENGTH column in SYSTABLES.)

count Number of frequent values that RUNSTATS is to collect.

Sort work data sets cannot span volumes. Smaller volumes require more sort work data sets to sort the same amount of data; therefore, large volume sizes can reduce the number of needed sort work data sets. When you allocate sort work data sets

on disk, the recommended amount of space to allow provides at least 1.2 times the amount of data that is to be sorted.

Related concepts:

"Data sets that online utilities use" on page 18

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

Concurrency and compatibility for RUNSTATS

The RUNSTATS utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats individual data and index partitions as distinct target objects. Utilities operating on different partitions of the same table space or index space are compatible.

Claims

The following table shows which claim classes RUNSTATS claims and drains and any restrictive state that the utility sets on the target object.

Table 108. Claim classes of RUNSTATS operations

Target	RUNSTATS TABLESPACE SHRLEVEL REFERENCE	RUNSTATS TABLESPACE SHRLEVEL CHANGE	RUNSTATS INDEX SHRLEVEL REFERENCE	RUNSTATS INDEX SHRLEVEL CHANGE
Table space or partition	DW/UTRO	CR/UTRW[1]	None	None
Index or partition	None	None	DW/UTRO	CR/UTRW

Legend:

- DW - Drain the write claim class - concurrent access for SQL readers.
- CR - Claim the read claim class.
- UTRO - Utility restrictive state - read-only access allowed.
- UTRW - Utility restrictive state - read-write access allowed.
- None - Object is not affected by this utility.

Note:

1. If the target object is a segmented table space, SHRLEVEL CHANGE does not allow you to concurrently execute an SQL searched DELETE without the WHERE clause.

Compatibility

The following table shows which utilities can run concurrently with RUNSTATS on the same target object. The target object can be a table space, an index space, or a partition of a table space or index space. If compatibility depends on particular options of a utility, that information is also shown in the table.

Table 109. Compatibility of RUNSTATS with other utilities

Utility	RUNSTATS TABLESPACE SHRLEVEL REFERENCE	RUNSTATS TABLESPACE SHRLEVEL CHANGE	RUNSTATS INDEX SHRLEVEL REFERENCE	RUNSTATS INDEX SHRLEVEL CHANGE
CHECK DATA DELETE NO	Yes	Yes	Yes	Yes
CHECK DATA DELETE YES	No	No	No	No
CHECK INDEX	Yes	Yes	Yes	Yes
CHECK LOB	Yes	Yes	Yes	Yes
COPY INDEXSPACE	Yes	Yes	Yes	Yes
COPY TABLESPACE	Yes	Yes	Yes	Yes
DIAGNOSE	Yes	Yes	Yes	Yes
LOAD	No	No	No	No
LOAD SHRLEVEL CHANGE	No	Yes	No	Yes
MERGECOPY	Yes	Yes	Yes	Yes
MODIFY RECOVERY	Yes	Yes	Yes	Yes
QUIESCE	Yes	Yes	Yes	Yes
REBUILD INDEX	Yes	Yes	No	No
RECOVER ERROR RANGE	No	No	Yes	Yes
RECOVER INDEX	Yes	Yes	No	No
RECOVER INDEX TOCOPY or TOLOGPOINT	No	No	No	No
RECOVER TABLESPACE (no options)	No	No	Yes	Yes
RECOVER TABLESPACE TOCOPY or TORBA	No	No	No	No
REORG INDEX	Yes	Yes	No	No
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No	No	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes	Yes	Yes	Yes
REPAIR DUMP or VERIFY	Yes	Yes	Yes	Yes
REPAIR LOCATE INDEX PAGE REPLACE	Yes	Yes	No	No
REPAIR LOCATE KEY or RID DELETE or REPLACE	No	No	No	Yes
REPAIR LOCATE TABLESPACE PAGE REPLACE	No	No	Yes	Yes
REPORT	Yes	Yes	Yes	Yes
RUNSTATS	Yes	Yes	Yes	Yes
STOSPACE	Yes	Yes	Yes	Yes
UNLOAD	Yes	Yes	Yes	Yes

Collecting distribution statistics for column groups

When RUNSTATS collects distribution statistics for columns groups, the utility invokes a sort program to sort the distribution statistics. This sort requires its own work data set. The DD name is STATWK01.

About this task

You can let this data set be dynamically allocated through the sort program, or you can allocate the data set through a DD statement in the job JCL.

If you need to control the size or placement of the data sets, use the JCL statements to allocate STATWK01.

Procedure

To collect distribution statistics for column groups:

- To let the work data set be dynamically allocated, remove the STATWK01 DD statements from the job and allocate the UTPRINT statement to SYSOUT.
- To let the sort program dynamically allocate this data set, specify the SORTDEV option in the RUNSTATS utility control statement.

Related reference:

"Data sets that RUNSTATS uses" on page 762

DB2 Sort

Related information:

DFSORT Application Programming Guide

Updating statistics for a partitioned table space

You can run RUNSTATS on one or more single partitions of one or more table spaces or indexes (including data-partitioned secondary indexes). When you run the utility on a single partition of an object, RUNSTATS uses the resulting partition-level statistics to update the aggregate statistics for the entire object.

For partition-by-growth table spaces, RUNSTATS waits to drain the table space or index if necessary. If the object does not drain, RUNSTATS continues trying to drain the object. However, RUNSTATS does not have its own options to control this drain behavior as some other utilities do. (Other utilities have the DRAIN_WAIT and RETRY options). Instead, RUNSTATS uses the IRLMRWT subsystem parameter value for the drain wait time and the UTIMOUT subsystem parameter value for the retry value. If RUNSTATS finds these values to be excessive, it uses a lower value.

Related reference:

RESOURCE TIMEOUT field (IRLMRWT subsystem parameter) (DB2 Installation and Migration)

UTILITY TIMEOUT field (UTIMOUT subsystem parameter) (DB2 Installation and Migration)

Collection of statistics on the DB2 catalog and directory

You can use the RUNSTATS utility to gather statistics for the DB2 catalog. DB2 uses the collected statistics on the catalog to determine the access path for user queries of the catalog. You cannot run RUNSTATS on any DB2 directory objects.

The following sample shows part of the output from a RUNSTATS job on a catalog table space and its indexes:

```
DSNU000I   DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = DSNTEX
DSNU050I   DSNUGUTC - RUNSTATS TABLESPACE DSNDB06.SYSDBASE INDEX(ALL)
DSNU610I # DSNUSUTP - SYSTABLEPART CATALOG UPDATE FOR DSNDB06.SYSDBASE SUCCESSFUL
DSNU610I # DSNUSUTS - SYSTABLESPACE CATALOG UPDATE FOR DSNDB06.SYSDBASE SUCCESSFUL
DSNU610I # DSNUSUTB - SYSTABLES CATALOG UPDATE FOR SYSIBM.SYSTABLESPACE SUCCESSFUL

DSNU610I # DSNUSUTB - SYSTABLES CATALOG UPDATE FOR SYSIBM.SYSSYNONYMS SUCCESSFUL
DSNU610I # DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR SYSIBM.DSNDSX01 SUCCESSFUL
DSNU610I # DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR SYSIBM.DSNDSX01 SUCCESSFUL
DSNU610I # DSNUSUCO - SYSCOLUMNS CATALOG UPDATE FOR SYSIBM.DSNDSX01 SUCCESSFUL
DSNU610I # DSNUSUFL - SYSFIELDS CATALOG UPDATE FOR SYSIBM.DSNDSX01 SUCCESSFUL

DSNU610I # DSNUSUIX - SYSINDEXES CATALOG UPDATE FOR SYSIBM.DSNDYX01 SUCCESSFUL
DSNU610I # DSNUSUIP - SYSINDEXPART CATALOG UPDATE FOR SYSIBM.DSNDYX01 SUCCESSFUL
DSNU610I # DSNUSUCO - SYSCOLUMN CATALOG UPDATE FOR SYSIBM.DSNDYX01 SUCCESSFUL
DSNU610I # DSNUSUFL - SYSFIELDS CATALOG UPDATE FOR SYSIBM.DSNDYX01 SUCCESSFUL
DSNU010I   DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Figure 93. Example RUNSTATS output from a job on a catalog table space

Collecting frequency statistics for data-partitioned secondary indexes

When RUNSTATS collects frequency statistics on at least one data-partitioned secondary index, the utility invokes a sort program to sort the statistics. This sort requires temporary sort work data sets. The DD name is ST01WK*nn*.

About this task

You can let the ST01WK*nn* data sets be dynamically allocated through the SORT program or allocate the data sets through DD statements in the job JCL. If you need to control the size or placement of the data sets, use the JCL statements to allocate ST01WK*nn*.

Procedure

To collect frequency statistics for data-partitioned secondary indexes:

- To let the sort work data sets be dynamically allocated, remove the ST01WK*nn* DD statements from the job and allocate the UTPRINT statement to SYSOUT.
- To let the SORT program dynamically allocate these data sets, specify the SORTDEV option in the RUNSTATS utility control statement to specify the device type for the temporary data sets. Optionally, you can also use the SORTNUM option to specify the number of temporary data sets to use.

Related reference:

"Data sets that RUNSTATS uses" on page 762

DB2 Sort

Related information:

DFSORT Application Programming Guide

Collecting statistics history

You can collect statistics history by using the RUNSTATS utility.

Procedure

To collect statistics history:

Specify the HISTORY option in the RUNSTATS utility control statement. When you specify HISTORY with a value other than NONE, RUNSTATS updates the catalog history tables with the access path statistics, space statistics, or both, depending on the parameter that you specify with HISTORY. The HISTORY option does not update the main catalog statistics that DB2 uses to select access paths. You can use the HISTORY option to monitor how statistics change over time without updating the main catalog statistics that DB2 uses to select access paths.

Related tasks:

Collecting history statistics (DB2 Performance)

Related reference:

History statistics (DB2 Performance)

Chapter 33, "RUNSTATS," on page 737

STATISTICS HISTORY field (STATHIST subsystem parameter) (DB2 Installation and Migration)

Collection of statistics on LOB table spaces

You can specify that RUNSTATS is to collect space statistics on a LOB table space. You can use these statistics to determine when the LOB table space should be reorganized. No statistics on the LOB table space affect access path selection.

Collection of statistics on XML objects

You can use separate RUNSTATS control statements to collect statistics on XML table spaces, or on their associated base table spaces.

You can specify that RUNSTATS collects space statistics on an XML table space. You can use those statistics to determine when the XML table space must be reorganized. Statistics that are collected on the XML table space also affect access path selection.

The following tables shows statistics values that are collected for the implicitly created XML DOCID columns. The

Table 110. Statistics that are collected on the XML DOCID column.

Catalog Table Name	Column Name	Meaning
SYSCOLSTATS	COLCARD	The number of distinct values in the XML column. This value is set to -2 for other types of XML objects.
SYSCOLSTATS	HIGHKEY	The highest value of the column. This value is set to blanks for other types of XML objects.
SYSCOLSTATS	HIGH2KEY	The second highest value of the column. This value is set to blanks for other types of XML objects.
SYSCOLSTATS	LOW2KEY	The second lowest value of the column. This value is set to blanks for other types of XML objects.

Table 110. Statistics that are collected on the XML DOCID column. (continued)

Catalog Table Name	Column Name	Meaning
SYSCOLSTATS	LOWKEY	The lowest value of the column. This value is set to blanks for other types of XML objects.
SYSCOLUMNS	COLCARDF	Estimated number of distinct values in the column. This value is set to -2 for other types of XML objects.
SYSCOLUMNS	HIGH2KEY	Second highest value in the column. This value is set to blanks for other types of XML objects.
SYSCOLUMNS	LOW2KEY	Second lowest value in the column. This value is set to blanks for other types of XML objects.

The following table shows that statistics values that are collected when RUNSTATS is run for XML indexes:

Table 111. Statistics that RUNSTATS collects for XML indexes

Catalog Table Name	Column Name	Meaning
SYSINDEXES	FIRSTKEYCARDF	The number of unique key values in the index.
SYSINDEXES	FULLKEYCARDF	The total number of key entries in the index.
SYSINDEXES	FIRSTKEYCARDF	The number of documents in the XML column. This value is collected only for implicitly created node ID indexes.
SYSINDEXES	CLUSTERRATIOF	This value is set to -2.
SYSKEYTARGETS	HIGH2KEY	For KEYSEQ=1, the second-highest key value.
SYSKEYTARGETS	LOW2KEY	For KEYSEQ=1, the second-lowest key value.
SYSKEYTARGETS	CARDF	The number of unique DOCID values in the index.
SYSKEYTARGETS	KEYCARDF	This value is set to -2.

RUNSTATS ignores the following keywords for certain types of objects in XML table spaces:

- COLGROUP
- KEYCARD (for indexes)
- FREQVAL MOST | LEAST | BOTH
- HISTOGRAM

DB2 issues message DSNU1345I when these keywords are ignored for an XML object.

XML indexes are related to XML tables, and not to the associated base tables. If you specify a base table space and an XML index in the same RUNSTATS control statement, DB2 generates an error. When you run RUNSTATS against a base table, RUNSTATS collects statistics only for indexes on the base table, including the document ID index.

Related concepts:

Filter factor estimation for the XMLEXISTS predicate (DB2 Performance)

Storage structure for XML data (DB2 Programming for XML)

XML data indexing (DB2 Programming for XML)

XML data and query performance (DB2 Performance)

Best practices for XML performance in DB2 (DB2 Performance)

Related information:

DSNU1354I (DB2 Messages)

Termination or restart of RUNSTATS

You can terminate and restart the RUNSTATS utility.

You can terminate RUNSTATS with the **TERM UTILITY** command.

You can restart a RUNSTATS utility job, but it starts from the beginning again.

Related tasks:

"Restarting an online utility" on page 52

Review of RUNSTATS output

The RUNSTATS utility updates columns in the catalog tables. When you specify REPORT YES, the RUNSTATS utility also generates a report of the statistics that it gathered.

The following table shows the catalog tables that RUNSTATS updates depending on the value of the UPDATE option, the value of the HISTORY option, and the source of the statistics (table space, partition, index or LOB table space).

Table 112. Catalog tables that RUNSTATS updates

Keyword	UPDATE option	HISTORY option	Catalog table that RUNSTATS updates
TABLESPACE	UPDATE ALL	HISTORY ALL [4]	SYSTABLESPACE SYSTABLEPART[1] SYSTABLEPART_HIST[1] SYSTABLES[1] SYSTABLES_HIST[1] SYSTABSTATS[1,2] SYSTABSTATS_HIST[1,2] SYSLOBSTATS[3] SYSLOBSTATS_HIST[3]
TABLESPACE	UPDATE ALL	HISTORY ACCESSPATH	SYSTABLESPACE SYSTABLES[1] SYSTABLES_HIST[1] SYSTABSTATS[1,2] SYSTABSTATS_HIST[1,2]
TABLESPACE	UPDATE ALL	HISTORY SPACE	SYSTABLEPART[1] SYSTABLEPART_HIST[1] SYSLOBSTATS[3] SYSLOBSTATS_HIST[3]
TABLESPACE	UPDATE ACCESSPATH[2]	HISTORY ALL [4]	SYSTABLESPACE SYSTABLES SYSTABLES_HIST SYSTABSTATS[2] SYSTABSTATS_HIST[2]
TABLESPACE	UPDATE ACCESSPATH[2]	HISTORY ACCESSPATH	SYSTABLESPACE SYSTABLES SYSTABLES_HIST SYSTABSTATS[2] SYSTABSTATS_HIST[2]

Table 112. Catalog tables that RUNSTATS updates (continued)

Keyword	UPDATE option	HISTORY option	Catalog table that RUNSTATS updates
TABLESPACE	UPDATE ACCESSPATH[2]	HISTORY SPACE	none
TABLESPACE	UPDATE SPACE[2]	HISTORY ALL [4]	SYSTABLEPART SYSTABLEPART_HIST SYSLOBSTATS[3] SYSLOBSTATS_HIST[3] SYSTABLES SYSTABLES_HIST
TABLESPACE	UPDATE SPACE[2]	HISTORY ACCESSPATH	none
TABLESPACE	UPDATE SPACE[2]	HISTORY SPACE	SYSTABLEPART SYSTABLEPART_HIST SYSLOBSTATS[3] SYSLOBSTATS_HIST[3] SYSTABLES SYSTABLES_HIST
TABLE	UPDATE ALL	HISTORY ALL [4]	SYSCOLUMNS SYSCOLSTATS[2]
TABLE	UPDATE ALL	HISTORY ACCESSPATH	SYSCOLUMNS SYSCOLSTATS[2]
TABLE	UPDATE ALL	HISTORY SPACE	none
TABLE	UPDATE ACCESSPATH	HISTORY ALL [4]	SYSCOLUMNS SYSCOLSTATS[2]
TABLE	UPDATE ACCESSPATH	HISTORY ACCESSPATH	SYSCOLUMNS SYSCOLSTATS[2]
TABLE	UPDATE ACCESSPATH	HISTORY SPACE	none
INDEX	UPDATE ALL	HISTORY ALL [4]	SYSCOLUMNS SYSCOLUMNS_HIST SYSCOLDIST SYSCOLDIST_HIST SYSCOLDISTSTATS[2] SYSCOLSTATS[2] SYSINDEXES SYSINDEXES _HIST SYSINDEXPART SYSINDEXPART_HIST SYSINDEXSTATS[2]
INDEX	UPDATE ALL	HISTORY ACCESSPATH	SYSCOLUMNS SYSCOLUMNS_HIST SYSCOLDIST SYSCOLDIST_HIST SYSCOLDISTSTATS[2] SYSCOLSTATS[2] SYSINDEXPART SYSINDEXPART_HIST SYSINDEXSTATS[2]
INDEX	UPDATE ALL	HISTORY SPACE	SYSINDEXES SYSINDEXES_HIST

Table 112. Catalog tables that RUNSTATS updates (continued)

Keyword	UPDATE option	HISTORY option	Catalog table that RUNSTATS updates
INDEX	UPDATE ACCESSPATH	HISTORY ALL [4]	SYSCOLUMNS SYSCOLUMNS_HIST SYSCOLDIST SYSCOLDIST_HIST SYSCOLDISTSTATS[2] SYSCOLSTATS SYSINDEXES SYSINDEXES _HIST SYSINDEXSTATS[2]
INDEX	UPDATE ACCESSPATH	HISTORY ACCESSPATH	SYSCOLUMNS SYSCOLUMNS_HIST SYSCOLDIST SYSCOLDIST_HIST SYSCOLDISTSTATS[2] SYSCOLSTATS SYSINDEXES SYSINDEXES _HIST SYSINDEXSTATS[2]
INDEX	UPDATE ACCESSPATH	HISTORY SPACE	SYSINDEXES SYSINDEXES_HIST
INDEX	UPDATE SPACE	HISTORY ALL [4]	SYSINDEXPART SYSINDEXPART_HIST SYSINDEXES[5] SYSINDEXES_HIST[5]
INDEX	UPDATE SPACE	HISTORY ACCESSPATH	none
INDEX	UPDATE SPACE	HISTORY SPACE	SYSINDEXPART SYSINDEXES[5]
INDEX[6]	UPDATE ALL	HISTORY ALL[4]	SYSKEYTARGETS SYSKEYTARGETS_HIST SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXPART_HIST SYSINDEXSTATS[2] SYSINDEXSTATS_HIST[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST SYSKEYTGTDIST_HIST
INDEX[6]	UPDATE ALL	HISTORY ACCESSPATH	SYSKEYTARGETS SYSKEYTARGETS_HIST SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXSTATS[2] SYSINDEXSTATS_HIST[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST SYSKEYTGTDIST_HIST

Table 112. Catalog tables that RUNSTATS updates (continued)

Keyword	UPDATE option	HISTORY option	Catalog table that RUNSTATS updates
INDEX[6]	UPDATE ALL	HISTORY SPACE	SYSKEYTARGETS SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXPART_HIST SYSINDEXSTATS[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST
INDEX[6]	UPDATE ACCESSPATH	HISTORY ALL[4]	SYSKEYTARGETS SYSKEYTARGETS_HIST SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXSTATS[2] SYSINDEXSTATS_HIST[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST SYSKEYTGTDIST_HIST
INDEX[6]	UPDATE ACCESSPATH	HISTORY ACCESSPATH	SYSKEYTARGETS SYSKEYTARGETS_HIST SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXSTATS[2] SYSINDEXSTATS_HIST[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST SYSKEYTGTDIST_HIST
INDEX[6]	UPDATE ACCESSPATH	HISTORY SPACE	SYSKEYTARGETS SYSKEYTARGETSTATS[2] SYSKEYTGTDISTSTATS[2] SYSINDEXPART SYSINDEXPART_HIST SYSINDEXSTATS[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST
INDEX[6]	UPDATE SPACE	HISTORY ALL[4]	SYSKEYTARGETS_HIST SYSINDEXPART SYSINDEXSTATS_HIST[2] SYSINDEXES SYSINDEXES_HIST SYSKEYTGTDIST_HIST
INDEX[6]	UPDATE SPACE	HISTORY ACCESSPATH	SYSINDEXPART SYSINDEXES SYSINDEXES_HIST
INDEX[6]	UPDATE SPACE	HISTORY SPACE	SYSINDEXPART SYSINDEXPART_HIST SYSINDEXES SYSINDEXES_HIST

Table 112. Catalog tables that RUNSTATS updates (continued)

Keyword	UPDATE option	HISTORY option	Catalog table that RUNSTATS updates

Note:

1. Not applicable if the specified table space is a LOB table space.
2. Only updated for partitioned objects. When you run RUNSTATS against single partitions of an object, RUNSTATS uses the partition-level statistics to update the aggregate statistics for the entire object. These partition-level statistics are contained in the following catalog tables:
   - SYSCOLSTATS
   - SYSCOLDISTSTATS
   - SYSTABSTATS
   - SYSINDEXSTATS
3. Applicable only when the specified table space is a LOB table space.
4. When HISTORY NONE is specified, none of the catalog history tables are updated.
5. Only the SPACEF and STATSTIME columns are updated.
6. Applicable only when the target object is an expression-based index.

RUNSTATS sets the following columns to -1 for universal table spaces and table spaces that are defined as LARGE:

- CARD in SYSTABLES
- CARD in SYSINDEXPART
- FAROFFPOS in SYSINDEXPART
- NEAROFFPOS in SYSINDEXPART
- FIRSTKEYCARD in SYSINDEXES
- FULLKEYCARD in SYSINDEXES

Related reference:

Statistics used for access path selection (DB2 Performance)

DB2 catalog tables (DB2 SQL)

Resetting access path statistics

You can use the RUNSTATS utility to remove old and out-of-date access path statistics for DB2 objects.

About this task

When the RUNSTATS utility is invoked over a period of time, statistics are collected incrementally for target objects. The combination of many changes to target objects and many RUNSTATS invocations, perhaps with different options, might result in some previously collected statistics becoming outdated. Such out-of-date statistics might cause DB2 to choose inefficient access paths for SQL statements. One solution is to invoke the RUNSTATS utility again to refresh the statistics. However, the task of formulating RUNSTATS invocations to solve the problem might prove difficult because of the complicated nature of the many previous RUNSTATS invocations.

When this situation occurs, you can invoke the RUNSTATS utility to reset the access path statistics for all tables and indexes in a specified table space. When you reset the statistics, the default values are used. No statistics are gathered or reported. Space statistics and real-time statistics are not reset for the specified objects. After your reset access path statistics, the previous values cannot be recovered if no statistics history is available.

Procedure

To reset access path statistics:

Invoke the RUNSTATS utility, and specify the following options:

1. Specify the RESET ACCESSPATH option.
2. Optional: Specify the HISTORY ACCESSPATH option to record that the access path statistics were reset in rows in the SYSIBM.SYSTABLES_HIST and SYSIBM.SYSINDEXES_HIST statistics tables. This option only records that the reset occurred and does not save the access path statistics values that are reset.

For example, you might issue the following utility control statement:

```
RUNSTATS TABLESPACE db-name.ts-name
TABLE table-name RESET ACCESSPATH
```

Statistics are not collected. Instead, the RUNSTATS utility resets the access path statistics.

Results

Certain catalog table rows are updated with default values, and rows are deleted from other catalog tables. All updated rows in the catalog tables contain the same timestamp value. Real-time statistics and space for the specified object are not reset. However, the dynamic statement cache is invalidated.

The following statistics are reset to the specified values:

SYSIBM.SYSTABLESPACE
The following values are changed:

Column	Changed value
NACTIVE	-1
NACTIVEF	-1
STATSTIME	The TIMESTAMP value for the reset operation

SYSIBM.SYSCOLUMNS
The following values are changed:

Column	Changed value
COLCARD	-1
COLCARDF	-1
HIGH2KEY	Zero-length blank
LOW2KEY	Zero-length blank
STATSTIME	The TIMESTAMP value for the reset operation
STATS_FORMAT	Blank

SYSIBM.SYSTABLES
The following values are changed:

Column	Changed value
CARD	-1

Column	Changed value
CARDF	-1
NPAGES	-1
NPAGESF	-1
PCTPAGES	-1
PCTROWCOMP	-1
STATSTIME	The TIMESTAMP value for the reset operation

SYSIBM.SYSINDEXES

The following values are changed:

Column	Changed value
CLUSTERED	'N'
NLEAF	-1
NLEVELS	-1
FIRSTKEYCARD	-1
FULLKEYCARD	-1
FIRSTKEYCARDF	-1
FULLKEYCARDF	-1
CLUSTERRATIO	0
CLSUTERRATIOF	0
DATAREPEATFACTORF	-1
STATSTIME	The TIMESTAMP value for the reset operation

SYSIBM.SYSKEYTARGETS

The following values are changed:

Column	Changed value
CARDF	-1
HIGH2KEY	Zero-length blank
LOW2KEY	Zero-length blank
STATSTIME	TIMESTAMP
STATS_FORMAT	Blank

Applicable rows are deleted from the following catalog tables for the specified objects:

- SYSIBM.SYSTABSTATS
- SYSIBM.SYSCOLSTATS
- SYSIBM.SYSINDEXSTATS
- SYSIBM.SYSCOLDIST
- SYSIBM.SYSCOLDISTSTATS
- SYSIBM.SYSKEYTARGETSTATS
- SYSIBM.SYSKEYTGTDIST

- SYSIBM.SYSKEYTGTDISTSTATS

What to do next

After resetting the statistics you might want to invoke the RUNSTATS utility again with different options to capture new statistics.

Related tasks:

Maintaining statistics in the catalog (DB2 Performance)

Improving filter factors by collecting cardinality and frequency statistics (DB2 Performance)

Collecting history statistics (DB2 Performance)

Related reference:

Statistics used for access path selection (DB2 Performance)

After running RUNSTATS

Certain activities might be required after you run the RUNSTATS utility, depending on your situation.

After running RUNSTATS with the UPDATE ACCESSPATH option, the UPDATE SPACE option, or the UPDATE ALL option, rebind any application plans that use the tables or indexes so that they use the new statistics.

Sample RUNSTATS control statements

Use the sample control statements as models for developing your own RUNSTATS control statements.

Example 1: Updating catalog statistics for a table space while allowing changes

The following control statement specifies that the RUNSTATS utility is to update the catalog with statistics for table space DSN8D81A.DSN8S11E and all of its associated tables and indexes. When updating the table statistics, RUNSTATS is to sample 25% of the rows. Although SHRLEVEL CHANGE is not specified, by default DB2 permits other processes to make changes to the table space while the RUNSTATS utility is executing.

```
//STEP1    EXEC DSNUPROC,UID='IUJQU225.RUNSTA',TIME=1440,
//         UTPROC='',
//         SYSTEM='DSN'
//UTPRINT  DD  SYSOUT=*
//SYSIN    DD *
RUNSTATS TABLESPACE DSN8D11A.DSN8S11E
   TABLE(ALL) SAMPLE 25
    INDEX(ALL)
```

Example 2: Updating index statistics

The following control statement specifies that RUNSTATS is to update the catalog statistics for index DSN8810.XEMPL1.

```
RUNSTATS INDEX (DSN8B10.XEMPL1)
```

Example 3: Updating index statistics while prohibiting updates

The following control statement specifies that RUNSTATS is to update the catalog statistics for indexes XEMPL1 and XEMPL2. DB2 does not permit other processes to change the table space that is associated with XEMPL1 and XEMPL2 (table space DSN8S11E) while this utility is executing. This restricted access is the default behavior.

```
RUNSTATS INDEX (DSN8B10.XEMPL1,DSN8B10.XEMPL2)
```

Example 4: Updating statistics for columns in several tables

The following control statement specifies that RUNSTATS is to update the catalog statistics for the following columns in table space DSN8D11P.DSN8S11C:

- All columns in the TCONA and TOPTVAL tables
- The LINENO and DSPLINE columns in the TDSPTXT table

```
RUNSTATS TABLESPACE(DSN8D11P.DSN8S11C)
         TABLE (TCONA)
         TABLE (TOPTVAL) COLUMN(ALL)
         TABLE (TDSPTXT) COLUMN(LINENO,DSPLINE)
```

Example 5: Updating all statistics for a table space

The following control statement specifies that RUNSTATS is to update all catalog statistics (table space, tables, columns, and indexes) for table space DSN8D81P.DSN8S81C.

```
RUNSTATS TABLESPACE(DSN8D11P.DSN8S11C) TABLE INDEX
```

Example 6: Updating statistics that are used for access path selection and generating a report

The following control statement specifies that RUNSTATS is to update the catalog with **only** the statistics that are collected for access path selection. The utility is to report **all** statistics for the table space and route the report to SYSPRINT.

```
RUNSTATS TABLESPACE DSN8D11A.DSN8S11E
  REPORT YES
  UPDATE ACCESSPATH
```

Example 7: Updating all statistics and generating a report

The following control statement specifies that RUNSTATS is to update the catalog with **all** statistics (access path and space) for table space DSN8D81A.DSN8S81E. The utility is also to report the collected statistics and route the report to SYSPRINT.

```
RUNSTATS TABLESPACE DSN8D11A.DSN8S11E
  REPORT YES
  UPDATE ALL
```

Example 8: Reporting statistics without updating the catalog

The following control statement specifies that RUNSTATS is to collect statistics for table space DSN8D81A.DSN8S81E and route the report to SYSPRINT. The utility is not to update the catalog with the collected statistics.

```
RUNSTATS TABLESPACE DSN8D11A.DSN8S11E
  REPORT YES
  UPDATE NONE
```

Example 9: Updating statistics for a partition

The following control statement specifies that RUNSTATS is to update the statistics for the first partition of table space DSN8D81A.DSN8S81E and the first partition of the DSN8810.XEMP1 index.

```
RUNSTATS TABLESPACE DSN8D11A.DSN8S11E PART 1 INDEX(DSN8B10.XEMP1 PART 1)
```

Example 10: Updating catalog and history tables and reporting all statistics

The following control statement specifies that RUNSTATS is to update the catalog tables and history catalog tables with all statistics for table space DB0E0101.TL0E0101 (including related indexes and columns). The utility is to report the collected statistics and route the statistics to SYSPRINT.

```
RUNSTATS TABLESPACE DBOE0101.TLOE0101
   INDEX
   TABLE
   REPORT YES
   UPDATE ALL
   HISTORY ALL
```

Example 11: Updating statistics on frequently occurring values

Assume that the SYSADM.IXNP1 index is defined on four columns: NP1, NP2, NP3, and NP4. The following control statement specifies that RUNSTATS is to update the statistics for index SYSADM.IXNPI.

The RUNSTATS utility collects cardinality statistics for column NP1, column set NP1 and NP2, and column set NP1, NP2, and NP3, and column set NP1, NP2, NP3, and NP4. The FREQVAL option and its associated parameters indicate that RUNSTATS is also to collect the 5 most frequently occurring values on column NP1 (the first key column of the index), and the 10 most frequently occurring values on the column set NP1 and NP2 (the first two key columns of the index). The utility is to report the collected statistics and route the statistics to SYSPRINT.

```
RUNSTATS INDEX (SYSADM.IXNPI)
           FREQVAL NUMCOLS 1 COUNT 5
           FREQVAL NUMCOLS 2 COUNT 10
           REPORT YES
```

Example 12: Updating distribution statistics for a group of specified columns in a table

The following control statement specifies that RUNSTATS is to update statistics for the columns EMPLEVEL, EMPGRADE, and EMPSALARY in table DSN8810.DEPT (in table space DSN8D81A.DSN8S81E). The statement uses the COLGROUP keyword to group these columns. RUNSTATS is to collect the cardinality of this column group and store the cardinality in the SYSCOLDIST catalog table.

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
TABLE(DSN8810.DEPT)
COLGROUP (EMPLEVEL,EMPGRADE,EMPSALARY)
```

Example 13: Updating distribution statistics for specific columns and retrieving the most frequently occurring values

The following control statement specifies that RUNSTATS is to update statistics for the columns EMPLEVEL, EMPGRADE, and EMPSALARY in table DSN8810.DEPT. The FREQVAL and COUNT options indicate that RUNSTATS is to collect the 10

most frequently occurring values for each column. The values are to be stored in the SYSCOLDIST and SYSCOLDISTSTATS catalog tables.

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
TABLE(DSN8810.DEPT)
COLGROUP(EMPLEVEL,EMPGRADE,EMPSALARY) FREQVAL COUNT 10
```

Example 14: Updating distribution statistics for specific columns in a table and retrieving the least frequently occurring values

The following control statement specifies that RUNSTATS is to update statistics for the columns EMPLEVEL, EMPGRADE, and EMPSALARY in table DSN8810.DEPT. The FREQVAL and COUNT options indicate that RUNSTATS is to collect the 15 least frequently occurring values for each column. The values are to be stored in the SYSCOLDIST and SYSCOLDISTSTATS catalog tables.

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
TABLE(DSN8810.DEPT)
COLGROUP(EMPLEVEL,EMPGRADE,EMPSALARY) FREQVAL COUNT 15 LEAST
```

Example 15: Updating distribution statistics for specific columns in a table space and retrieving the most and least frequently occurring values

The following control statement specifies that RUNSTATS is to update statistics for the columns EMPLEVEL, EMPGRADE, and EMPSALARY in table DSN8810.DEPT. The FREQVAL and COUNT options indicate that RUNSTATS is to collect the 10 most frequently occurring values for each column and the 10 least frequently occurring values for each column. The values are to be stored in the SYSCOLDIST and SYSCOLDISTSTATS catalog tables.

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
TABLE(DSN8810.DEPT)
COLGROUP(EMPLEVEL,EMPGRADE,EMPSALARY) FREQVAL COUNT 10 BOTH
```

Example 16: Updating statistics for an index and retrieving the most and least frequently occurring values

The following control statement specifies that RUNSTATS is to collect the 10 most frequently occurring values and the 10 least frequently occurring values for the first key column of index ADMF001.IXMA0101. By default, the utility collects all the distinct values in all the key column combinations. A set of messages is sent to SYSPRINT and all collected statistics are updated in the catalog.

```
RUNSTATS INDEX(ADMF001.IXMA0101)
FREQVAL NUMCOLS 1 COUNT 10 BOTH
REPORT YES UPDATE ALL
```

Example 17: Invalidating statements in the dynamic statement cache for a table space without generating report statistics.

The following control statement specifies that RUNSTATS is to invalidate statements in the dynamic statement cache for table space DSN8D81A.DSN8S81E. However, RUNSTATS is not to collect or report statistics or update the catalog.

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
REPORT NO
UPDATE NONE
```

Example 18: RUNSTATS HISTOGRAM job statement.

The following control statement specifies that RUNSTATS is to gather histogram statistics for the specified key columns. Histogram statistics can only be collected on the prefix columns with the same order.

```
RUNSTATS TABLESPACE RVTDB01.RVTTS01
INDEX ALL
HISTOGRAM NUMCOLS 2   NUMQUANTILES 5
SHRLEVEL(CHANGE)
UPDATE ALL
REPORT YES
```

Chapter 34. STOSPACE

The STOSPACE online utility updates DB2 catalog columns that indicate how much space is allocated for storage groups and related table spaces and indexes.

For user-defined spaces, STOSPACE does not record any statistics.

Output

The output from STOSPACE consists of updated values in the columns and tables in the following list. In each case, an amount of space is given in kilobytes (KB). If the value is too large to fit in the SPACE column, the SPACEF column is updated.

- SPACE in SYSIBM.SYSINDEXES shows the amount of space that is allocated to indexes. If the index is not defined using STOGROUP, or if STOSPACE has not been executed, the value is zero.
- SPACE in SYSIBM.SYSTABLESPACE shows the amount of space that is allocated to table spaces. If the table space is not defined using STOGROUP, or if STOSPACE has not been executed, the value is zero.
- SPACE in SYSIBM.SYSINDEXPART shows the amount of space that is allocated to index partitions. If the partition is not defined using STOGROUP, or if STOSPACE has not been executed, the value is zero.
- SPACE in SYSIBM.SYSTABLEPART shows the amount of space that is allocated to table partitions. If the partition is not defined using STOGROUP, or if STOSPACE has not been executed, the value is zero.
- SPACE in SYSIBM.SYSSTOGROUP shows the amount of space that is allocated to storage groups.
- STATSTIME in SYSIBM.SYSSTOGROUP shows the timestamp for the time at which STOSPACE was last executed.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- STOSPACE privilege
- SYSCTRL or SYSADM authority

Execution phases of STOSPACE

The STOSPACE utility operates in these phases:

Phase Description

UTILINIT
Performs initialization

STOSPACE
Gathers space information and updates catalog

UTILTERM
Performs cleanup

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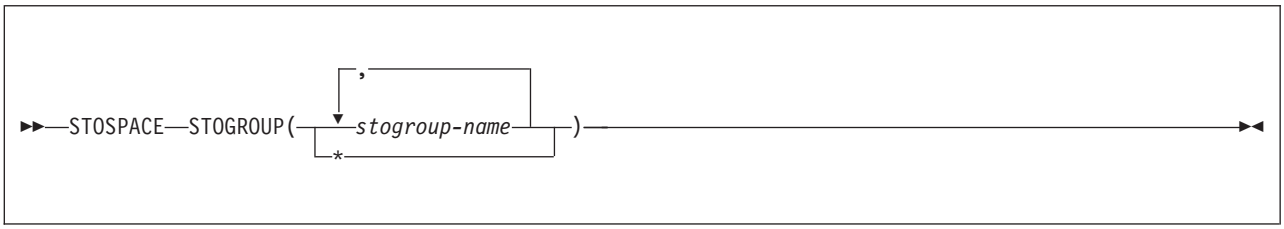
Syntax and options of the STOSPACE control statement

The STOSPACE utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



Option descriptions

STOGROUP
Identifies the storage groups that are to be processed.

(*stogroup-name*, ...)
Specifies the name of a storage group. You can use a list of from one to 255 storage group names. Separate items in the list by commas, and enclose them in parentheses.

***** Indicates that all storage groups are to be processed.

Data sets that STOSPACE uses

The STOSPACE utility uses a number of data sets during its operation.

The following table lists the data sets that STOSPACE uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 113. Data sets that STOSPACE uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Storage group
Object that is to be reported.

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for STOSPACE

The STOSPACE utility has certain concurrency and compatibility characteristics associated with it.

STOSPACE does not set a utility restrictive state on the target object.

STOSPACE can run concurrently with any utility on the same target object. However, because STOSPACE updates the catalog, concurrent STOSPACE utility jobs or other concurrent applications that update the catalog might cause timeouts and deadlocks.

You can use the STOSPACE utility on storage groups that have objects within temporary databases.

How STOSPACE ensures availability of objects it STOSPACE requires

For each specified storage group, STOSPACE looks at the SYSIBM.SYSTABLESPACE and SYSIBM.SYSINDEXES catalog tables to determine which objects belong to that storage group.

For each object, the amount of allocated space is determined from an appropriate VSAM catalog. Hence the table spaces and indexes do not need to be available to DB2 when STOSPACE is running; only the DB2 catalog and appropriate VSAM catalogs are required. However, to gain access to the VSAM catalog, the utility must have available to it the database definition (DBD) for the objects that are involved. This access requires that the appropriate database, table spaces, and index spaces not be in the stopped state.

Obtaining statistical information with STOSPACE

When DB2 storage groups are used in the creation of table spaces and indexes, DB2 defines the data sets for them. The STOSPACE utility permits a site to monitor the disk space that is allocated for the storage group.

About this task

The following table lists statistical information that the STOSPACE utility records and that is useful for making space allocation decisions.

GUPI

Table 114. DB2 catalog data that STOSPACE collects

Catalog table	Column name	Column description
SYSTABLESPACE	SPACEF	Number of kilobytes of storage that are allocated to the table space
SYSTABLEPART	SPACEF	Number of kilobytes of storage that are allocated to the table space partition
SYSINDEXES	SPACEF	Number of kilobytes of storage that are allocated to the index
SYSINDEXPART	SPACEF	Number of kilobytes of storage that are allocated to the index partition
SYSSTOGROUP	SPACEF	Number of kilobytes of storage that are allocated to the storage group

Table 114. DB2 catalog data that STOSPACE collects (continued)

Catalog table	Column name	Column description
SYSSTOGROUP	STATSTIME	Time when STOSPACE was last run on a particular storage group

GUPI

STOSPACE does not accumulate information for more than one storage group. If a partitioned table space or index space has partitions in more than one storage group, the information in the catalog about that space comes from only the group for which STOSPACE was run.

When you run the STOSPACE utility, the SPACEF column of the catalog represents the high-allocated RBA of the VSAM linear data set. Use the value in the SPACEF column to project space requirements for table spaces, table space partitions, index spaces, and index space partitions over time. Use the output from the Access Method Services LISTCAT command to determine which table spaces and index spaces have allocated secondary extents. When you find these, increase the primary quantity value for the data set, and run the REORG utility.

Procedure

- For information about space utilization in the DSN8S11E table space in the DSN8D11A database:
  1. Run the STOSPACE utility
  2. Execute the following SQL statement: GUPI

```
EXEC SQL
  SELECT SPACE
  FROM SYSIBM.SYSTABLESPACE
  WHERE NAME = 'DSN8S11E
  AND DBNAME = 'DSN8D11A'
ENDEXEC
```

GUPI

  Alternatively, you can use TSO to look at data set and pack descriptions.
- To update SYSIBM.SYSSTOGROUP for storage group DSN8G110, as well as SYSIBM.SYSTABLESPACE and SYSIBM.SYSINDEXES, for every table space and index that belongs to DSN8G110, use the following utility control statement:

```
STOSPACE STOGROUP DSN8G110
```

Analysis of the values in a SPACE or SPACEF column

The value in a SPACE or SPACEF column represents total allocated space, not only the space that is allocated on the current list of volumes in the storage groups. If the value is too large to fit in the SPACE column, the SPACEF column is used.

You can delete volumes from a storage group even though space on those volumes is still allocated to DB2 table spaces or indexes. Deletion of a volume from a storage group prevents future allocations; it does not withdraw a current allocation.

Termination or restart of STOSPACE

You can terminate and restart the STOSPACE utility.

You can terminate a STOSPACE utility job with the **TERM UTILITY** command if you have submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart a STOSPACE utility job, but it starts from the beginning again.

Related tasks:

"Restarting an online utility" on page 52

Sample STOSPACE control statement

Use the sample control statements as models for developing your own STOSPACE control statements.

Example 1: Updating catalog SPACE columns for a particular storage group

The following control statement specifies that the STOSPACE utility is to update the catalog SPACE or SPACEF columns for storage group DSN8G110 and any related table spaces and indexes.

```
//STEP1    EXEC DSNUPROC,UID='FUAUU330.STOSPCE',
//         UTPROC='',
//         SYSTEM='DSN'
//SYSIN    DD *
STOSPACE STOGROUP DSN8G110
//*
```

Example 2: Specifying a storage group name that contains spaces

If the name of the storage group that you want STOSPACE to process contains spaces, enclose the entire storage group name in single quotation marks. Parentheses are optional. The following statements are correct ways to specify a storage group with the name THIS IS STOGROUP.1.ON.E:

```
STOSPACE STOGROUP('THIS IS STOGROUP.1.ONE')

STOSPACE STOGROUP 'THIS IS STOGROUP.1.ONE'
```

Example 3: Updating catalog SPACE columns for all storage groups

The following control statement specifies that the STOSPACE utility is to update the catalog SPACE or SPACEF columns for all storage groups.

```
STOSPACE STOGROUP *
```

Example 4: Updating catalog SPACE columns for several storage groups

The following control statement specifies that the STOSPACE utility is to update the catalog SPACE or SPACEF columns for storage groups DSN8G110 and DSN8G81U.

```
STOSPACE STOGROUP(DSN8G810, DSN8G81U)
```

Chapter 35. TEMPLATE

The TEMPLATE online utility control statement lets you allocate data sets, without using JCL DD statements, during the processing of a LISTDEF list. The TEMPLATE control statement defines the data set naming convention. TEMPLATE control statements can also be written to contain allocation parameters that define data set size, location, and attributes.

Templates enable you to standardize data set names across the DB2 subsystem and to easily identify the data set type when you use variables in the data set name.

The TEMPLATE control statement uses the z/OS DYNALLOC macro (SVC 99) to perform data set allocation. Therefore, the facility is constrained by the limitations of this macro and by the subset of DYNALLOC that is supported by TEMPLATE. See z/OS MVS Programming: Authorized Assembler Services Guide for more details.

Output

The TEMPLATE control statement generates a dynamic allocation template with an assigned name for later reference.

Authorization required

No privileges are required to execute this control statement. When a TEMPLATE is referenced by a specific utility, privileges are checked at that time.

Execution phases of TEMPLATE

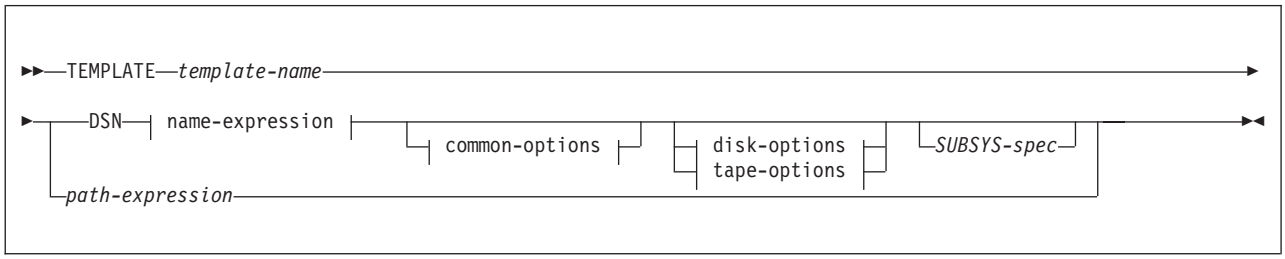
The TEMPLATE control statement executes entirely in the UTILINIT phase, which performs setup for the subsequent utility.

Syntax and options of the TEMPLATE control statement

The TEMPLATE utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



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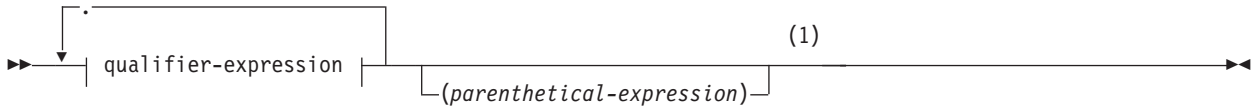
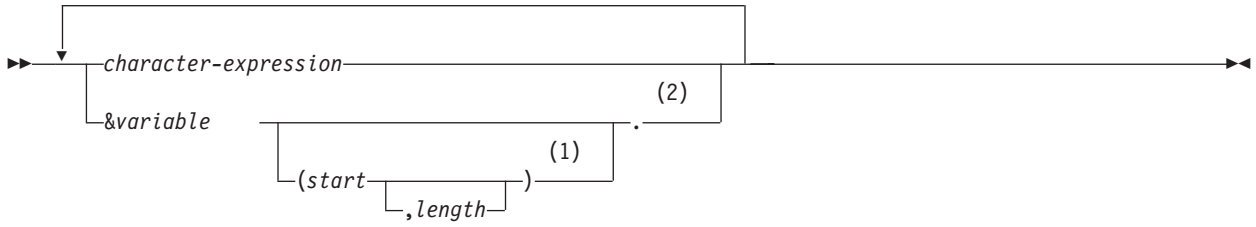
name-expression:



Notes:

1 The entire name-expression represents one character string and cannot contain any blanks.

qualifier-expression:

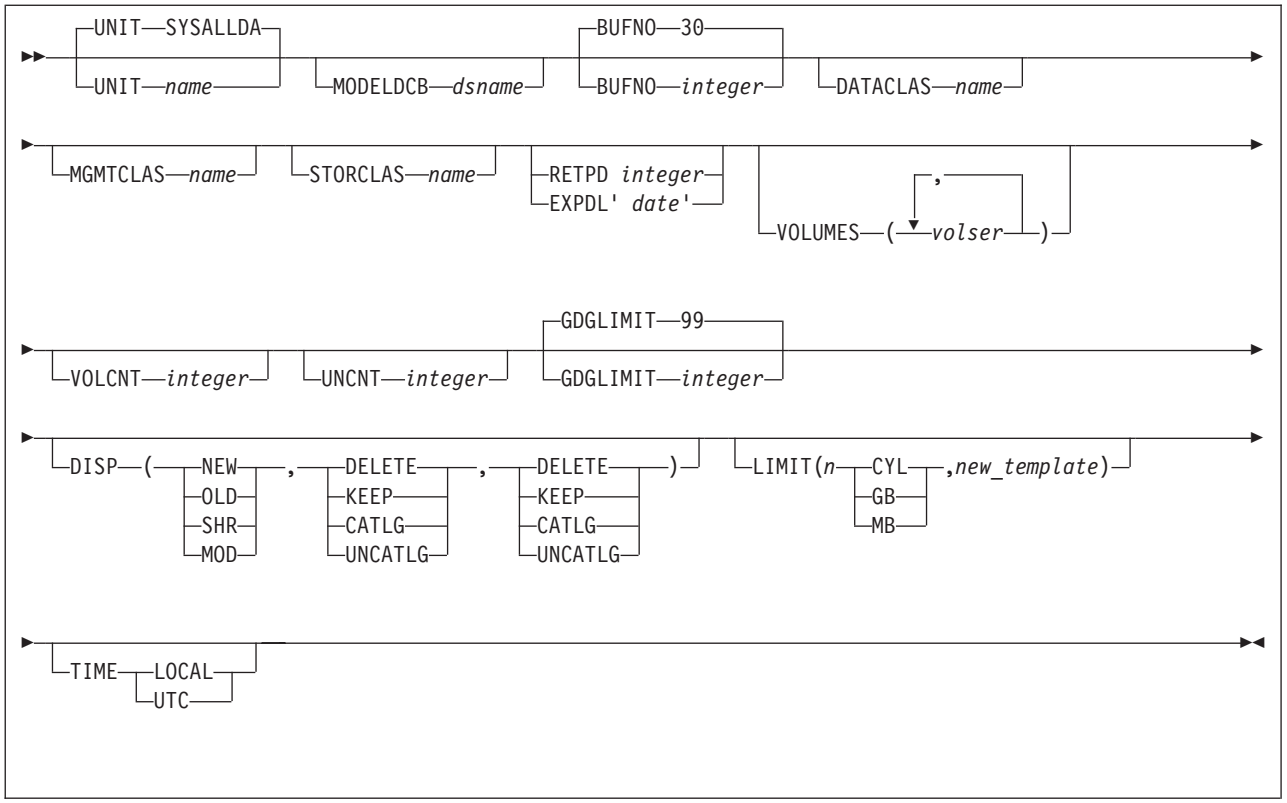


Notes:

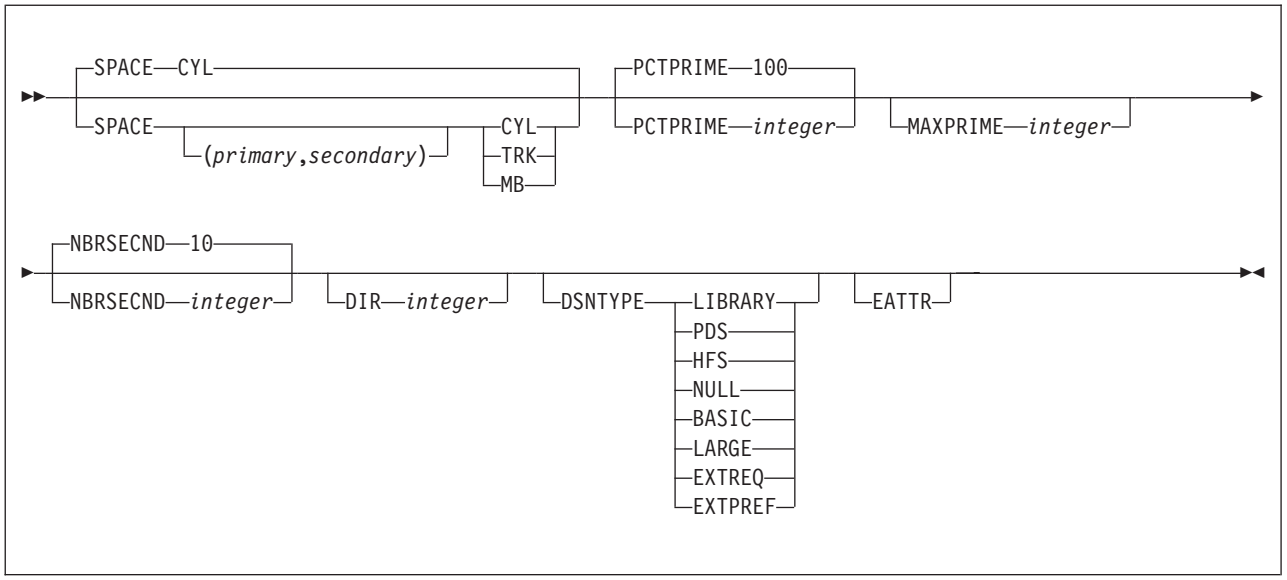
1 If you use substring notation, the entire DSN operand must be enclosed in single quotation marks. For example, the DSN operand `'P&PA(4,2).'` uses substring notation, so it is enclosed in single quotation marks.

2 The `&PA.` variable cannot be used more than once.

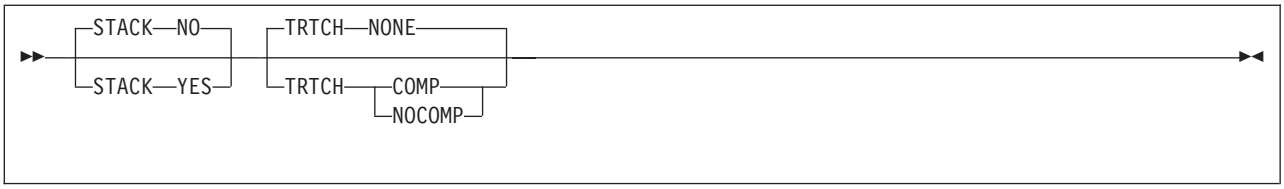
common-options:



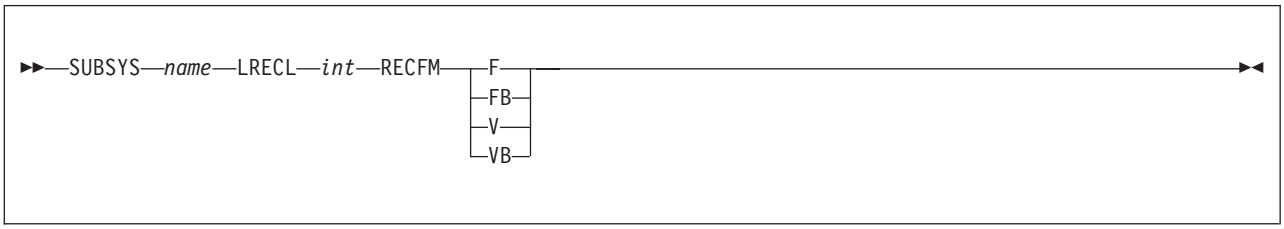
disk-options:



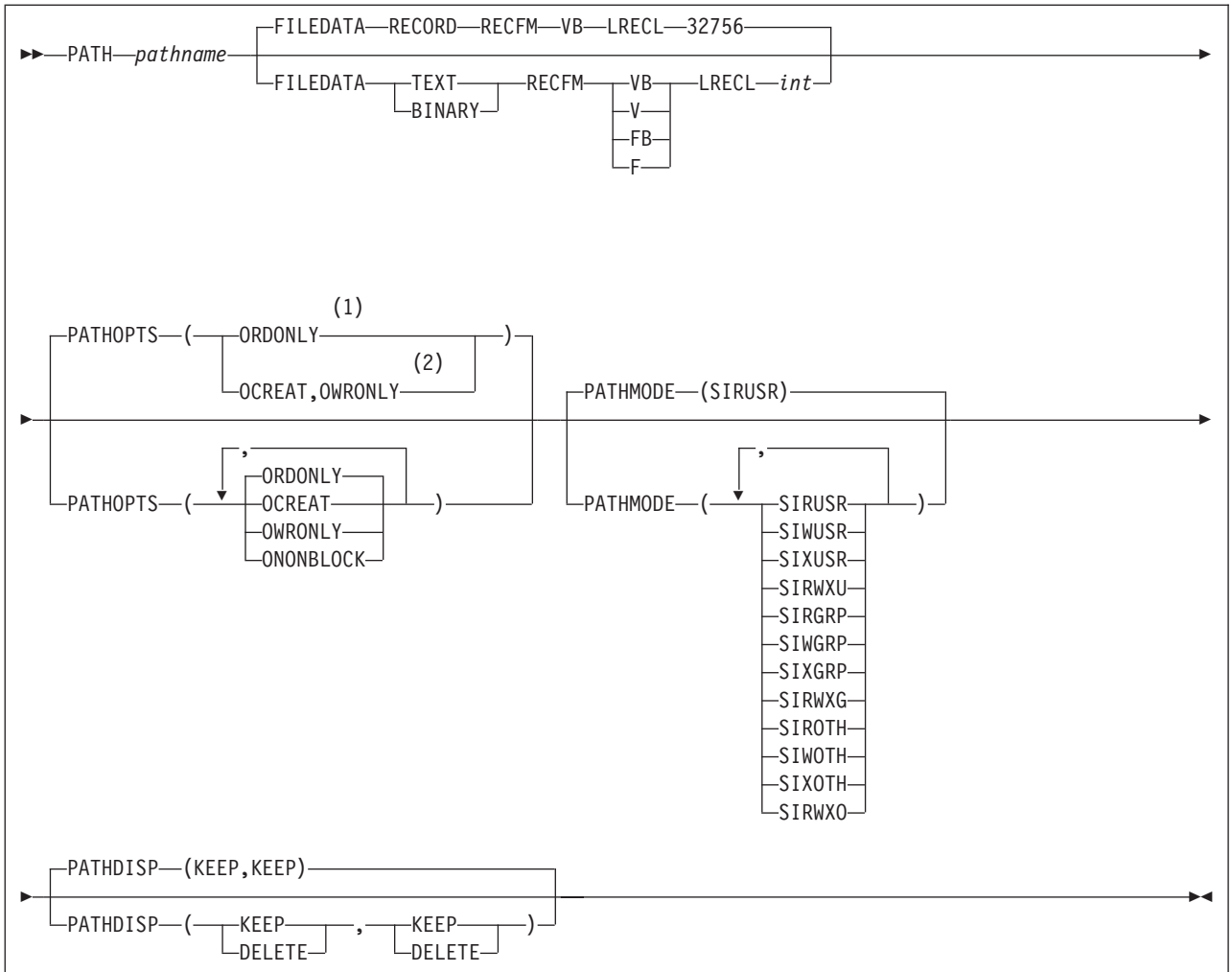
tape-options:



SUBSYS-spec



path-expression



Notes:

1 For LOAD, the default is PATHOPTS(ORDONLY).

2 For UNLOAD, the default is PATHOPTS(OCREAT,OWRONLY).

Option descriptions

TEMPLATE *template-name*

Defines a data set allocation template and assigns to the template a name, *template-name*, for subsequent reference on a DB2 utility control statement. The *template-name* can have up to eight alphanumeric characters and must begin with an alphabetic character.

template-name cannot be UTPRINT or SORTLIB, and cannot begin with SORTWK or SYS.

The *template-name* is followed by keywords that control the allocation of tape and disk data sets. A single TEMPLATE statement cannot have both disk options and tape options. The UNIT keyword specifies a generic unit name that is defined on your system. This value is used to determine if a disk or

tape data set is being allocated. All other keywords specified on the TEMPLATE control statement must be consistent with the specified unit type.

DSN *name-expression*
Specifies the template for the z/OS data set name. You can specify the data set name, *name-expression*, by using symbolic variables, non-variable alphanumeric, or national characters, or any combination of these characters. The resulting name must adhere to the z/OS data set naming rules, including those rules about name length, valid characters, name structure and qualifier length. You must specify a DSN expression that is unique for each data set allocated by the utility and to each invocation of the utility.

Templates for FlashCopy image copies should specify only DSN *name-expression*. DB2 does not use any other options in a TEMPLATE control statement for FlashCopy image copies.

Data set names consists of a series of qualifiers, *qualifier-expression*, that are separated by a period (.) and an optional parenthetical expression. No imbedded blanks are allowed. A partitioned data set (PDS) cannot be defined by TEMPLATE for use as an input data set.

If the DSN name operand contains any special characters, it must be enclosed in single quotation marks. For example, in the following TEMPLATE statement, the DSN operand contains the parentheses special character, so the entire operand is enclosed in single quotation marks:

```
TEMPLATE X DSN 'A.GDG.VERSION(+1)'
```

Parentheses around the DSN name operand are optional. They are used in the following DSN specification:

```
DSN(&DB..&TS..D&DATE.)
```

character-expression
Specifies the data set name or part of the data set name by using non-variable alphanumeric or national characters.

parenthetical-expression
Specifies part of the data set name by using non-variable alphanumeric or national characters that are enclosed in parentheses. For example, the expressions `Q1.Q2.Q3(member)` and `Q1.Q2.Q3(+1)` use valid parenthetical expressions. No variable substitution is performed within the parenthetical expression.

&variable.
Specifies the data set name or part of the data set name by using symbolic variables. See the following tables for a list of variables that can be used.

Each symbolic variable is substituted with its related value at execution time to form a specific data set name. When used in a DSN expression, substitution variables begin with an ampersand sign (&) and end with a period (.), as in the following example:

```
DSN &DB..&TS..D&JDATE..COPY&ICTYPE.
```

Using numeric variables alone generates an invalid data set qualifier for all numeric-type variables (all date or time-type variables, and others, such as &SEQ. or &PART.). These variables must be preceded by character constants to form valid DSN qualifiers. The following examples are valid specifications:

```
P&PART.
D&DATE.
```

Some substitution variables are invalid if you use TEMPLATE with an incompatible utility. For example, ICTYPE is not meaningful if the TEMPLATE statement is used with LOAD SYSDISC. Other variables assume default values when their values are not known. For example, &PART. becomes 00000 for non-partitioned objects.

You can also use substring notation for data set name variables. This notation can help you keep the data set name from exceeding the 44 character maximum. If you use substring notation, the entire DSN operand must be enclosed in single quotation marks. To specify a substring, use the form &variable(start). or &variable(start,length).

start
Specifies the substring's starting byte location within the current variable base value at the time of execution. *start* must be an integer from 1 to 128.

length
Specifies the length of the substring. If you specify *start* but do not specify *length*, *length*, by default, is the number of characters from the *start* character to the last character of the variable value at the time of execution. For example, given a five-digit base value, `&PART(4).` specifies the fourth and fifth digits of the value. *length* must be an integer that does not cause the substring to extend beyond the end of the base value.

For UNLOAD on a partitioned table space, if you use substring notation for the partition variable (&PART. or &PA.) in the DSN argument, the data set name might not be unique for all partitions, so DB2 cannot do parallel UNLOAD operations for the partitions. Therefore, DB2 sets the value of &PA to '00000', and uses a single UNLDDN data set for all partitions. This action might cause duplicate data set errors on subsequent UNLOAD jobs for other partitions of the same table space.

The following table contains a list of JOB variables and their descriptions.

Table 115. JOB variables

Variable	Description
`&JOBNAME.` or `&JO.`	The z/OS job name.
`&STEPNAME.` or `&ST.`	The z/OS step name. This variable might be needed if data set names from two different job steps conflict.
`&USERID.` or `&US.`	The user ID of the person that is running the utility. The value is 1 to 8 characters long.
`&UTILID.` or `&UT.`	The utility ID truncated to eight characters and checked for invalid DSN characters.
`&SSID.` or `&SS.`	Subsystem ID (non-data sharing) or group attachment name (data sharing).

The following table contains a list of UTILITY variables and their descriptions.

Table 116. UTILITY variables

Variable	Description
`&ICTYPE.` or `&IC.`	Single-character image copy type. This variable is valid only for image copy templates. The substitution is governed by whether a full image copy (F), an incremental image copy (I), or a CHANGELIMIT image copy (C) is specified by the user.

Table 116. UTILITY variables (continued)

Variable	Description
&UTILNAME. or &UN.	Special values are assigned to some utilities: CHECKD for CHECK DATA, CHECKI for CHECK INDEX, CHECKL for CHECK LOB, REORGI for REORG INDEX, and REORGT for REORG TABLESPACE. Utility names that are longer than eight characters are truncated to eight characters.
&SEQ. or &SQ.	Sequence number of the LISTDEF list item being processed.
&LOCREM. or &LR.	Indicator of whether *ddname* is for the local site (COPYDDN) or the recovery site (RECOVERYDDN). Single character L is used when the utility defines a COPYDDN *ddname*. The single character R is used when the utility defines a RECOVERYDDN *ddname*. You can replicate the SYSCOPY ICBACKUP column information by using both the &LOCREM. and &PRIBAC. variables. This variable is valid only for image copy templates.
&PRIBAC. or &PB.	Indicator of whether *ddname* is for the primary (*ddname1*) or backup (*ddname2*) copy data set. Single character P is used when the utility defines a *ddname1*. The single character B is used when the utility defines a *ddname2*. You can replicate the SYSCOPY ICBACKUP column information by using both the &LOCREM. and &PRIBAC. variables. This variable is valid only for image copy templates.

The following table contains a list of OBJECT variables and their descriptions.

Table 117. OBJECT variables

Variable	Description
&LIST. or &LI.	The name of the list that is defined by using the LISTDEF control statement and that is referenced on the same control statement as this TEMPLATE. This variable is used with COPY FILTERDDN templates. All objects in the list are copied to one data set, which makes &TS. and &IS. meaningless.
&DB.	Database name.
&TS.[1]	Table space name.
&IS.[1]	Index space name.
&SN.[1]	Space name (table space or index space).
&PART. or &PA.[2, 3, 4]	Five-digit partition number, padded with leading zeros.
&DSNUM[3, 4]	Five-digit partition number for partitioned objects, or five-digit piece number for linear objects, padded with leading zeroes.

Table 117. OBJECT variables (continued)

Variable	Description
Note:	
1. When you specify the &TS., &IS., or &SN. variables in a template that is used by an UNLOAD statement with BLOBF, CLOBF, or DBCLOBF, DB2 substitutes the name of the table space that stores the LOB column value, not the base table space name. This substitution enables DB2 to generate unique data set names for each LOB column with partitioned table spaces.	
2. Use the &PA. variable when processing LISTDEF lists with the PARTLEVEL keyword or data-partitioned secondary indexes. Otherwise, DB2 could generate duplicate data set names.	
3. Templates for FlashCopy image copies can contain either &PART or &DSNUM. If you are copying both partitioned and linear objects, use &DSNUM.	
4. FlashCopy image copies are always made at the partition or piece level. This behavior occurs even if you request FlashCopy image copies with DSNUM ALL on your COPY utility statement or include them in a LISTDEF list without the PARTLEVEL keyword. Therefore, for templates with the &PART., &PA., or &DSNUM. variables for FlashCopy image copies, the number and names of data sets that result might differ from the result when the same templates are used by other utilities. The result might also differ from the data set names that are displayed when you preview the templates. (For information about previewing templates, see "Key TEMPLATE operations" on page 806.)	

The following table contains a list of DATE and TIME variables. and their descriptions.

Table 118. DATE and TIME variables

Variable	Description
`&DATE.` or `&DT.`	YYYYDDD
`&TIME.` or `&TI.`	HHMMSS
`&JDATE.` or `&JU.`	YYYYDDD
`&YEAR.` or `&YE.`	YYYY portion of `&DATE.`
`&MONTH.` or `&MO.`	MM
`&DAY.` or `&DA.`	DD
`&JDAY.` or `&JD.`	DDD portion of `&DATE.`
`&HOUR.` or `&HO.`	HH portion of `&TIME.`
`&MINUTE.` or `&MI.`	MM portion of `&TIME.`
`&SECOND.` or `&SC.`	SS portion of `&TIME.`
`&UNIQ.` or `&UQ.`	Unique eight characters that DB2 derives from the system clock at the time of allocation. This set of characters begins with an alphabetical character and is followed by seven alphabetical or numeric characters.
Note: Date and time values are set with the STCK instruction. The value is in local time or Coordinated Universal Time (UTC) depending on the *TIME* option or TEMPLATE_TIME subsystem parameter. Except for the`&UNIQ.` and `&UQ.` variables, DATE and TIME values are captured in the UTILINIT phase of each utility and remain constant until the utility terminates. `&UNIQ.` and `&UQ.` are assigned a unique value for each allocation.	

SUBSYS name

Specifies the MVS BATCHPIPES SUBSYSTEM name. The SUBSYS operand must be a valid BATCHPIPES SUBSYSTEM name and must not exceed eight characters in length. When SUBSYS is specified, LRECL and RECFM are

required. When SUBSYS is specified, TEMPLATE keywords that are not compatible with SUBSYS (such as UNIT) are ignored.

Restriction: When using BATCHPIPES, TEMPLATE with the SUBSYS keyword, the utility cannot be restarted and the LOAD DISCARDDN keyword is not supported.

LRECL int
Specifies the record length of the MVS BATCHPIPES SUBSYSTEM file or z/OS UNIX file. You must specify LRECL if you specify SUBSYS.

LRECL does not have a default value except in the following situation: If you specify TEMPLATE PATH and accept the default value FILEDATA RECORD, the default value for LRECL is 32756.

RECFM
Specifies the record format of the MVS BATCHPIPES SUBSYSTEM file or z/OS UNIX file. You must specify RECFM if you specify SUBSYS.

Valid values for RECFM are F, FB, V, or VB

RECFM does not have a default value except in the following situation: If you specify TEMPLATE PATH and accept the default value FILEDATA RECORD, the default value for RECFM is VB.

UNIT
Specifies the device-number, device-type (generic), or group-name for the data set. All other TEMPLATE keywords are validated based on the specified type of unit (disk or tape).

The default value is **SYSALLDA**.

MODELDCB *dsname*
Specifies the name of the data set on which the template is based. DCB information is read from this model data set.

BUFNO *integer*
Specifies the number of BSAM buffers. The specified value must be in the range from 0 to 99.

The default value is **30**.

DATACLAS *name*
Specifies the SMS data class. The *name* value must be a valid SMS data class and must not exceed eight characters in length.

The data set is cataloged if DATACLAS is specified. If this option is omitted, no DATACLAS is specified to SMS.

MGMTCLAS *name*
Specifies the SMS management class. The *name* value must be a valid SMS management class and must not exceed eight characters in length.

The data set is cataloged if MGMTCLAS is specified. If this option is omitted, no MGMTCLAS is specified to SMS.

STORCLAS *name*
Specifies the SMS storage class. The *name* value must be a valid SMS storage class and must not exceed eight characters in length.

The data set is cataloged if STORCLAS is specified. If this option is omitted, no STORCLAS is specified to SMS.

RETPD *integer*
Specifies the retention period in days for the data set. The integer value must be in the range from 0 to 9999.

If DATACLAS, MGMTCLAS, or STORCLAS is specified, the class definition might control the retention. RETPD cannot be specified with EXPDL.

EXPDL *'date'*
Specifies the expiration date for the data set, in the form YYYYDDD, where YYYY is the four-digit year, and DDD is the three-digit Julian day. The 'date' value must be enclosed by single quotation marks.

If DATACLAS, MGMTCLAS, or STORCLAS is specified, the class definition might control the retention. EXPDL cannot be specified with RETPD.

VOLUMES *(vol1,vol2,...)*
Specifies a list of volume serial numbers for this allocation. If the data set is not cataloged the list is truncated, if necessary, when it is stored in SYSIBM.SYSCOPY. The specified number of volumes cannot exceed the specified or default value of VOLCNT.

The first volume must contain enough space for the primary space allocation.

If an individual volume serial-number contains leading zeros, it must be enclosed in single quotation marks.

VOLCNT *(integer)*
Specifies the maximum number of volumes that an output data set might require. The specified value must be between 0 and 255.

The default value for tape templates is **95**. For disk templates, the utility does not set a default value. Operating system defaults apply.

UNCNT *integer*
Specifies the number of devices that are to be allocated. The specified value must in the range from 0 to 59.

If UNIT specifies a specific device number, the value of UNCNT must either be 1 or be omitted.

GDGLIMIT *(integer)*
Specifies the number of entries that are to be created in a GDG base if a GDG DSN is specified and the base does not already exist. If a GDG base does not already exist and you do not want to define one, specify a GDGLIMIT of zero (0).

The default value is **99**. The integer value must be in the range from 0 to 255.

DISP (*status***,** *normal-termination***,** *abnormal-termination***)**
Specifies the data set disposition by using three positional parameters: status, normal-termination, and abnormal-termination. All three parameters must be specified.

status
Standard z/OS values are allowed: NEW, OLD, SHR, MOD.

normal-termination
Standard z/OS values are allowed: DELETE, KEEP, CATLG, UNCATLG.

abnormal-termination
Standard z/OS values are allowed: DELETE, KEEP, CATLG, UNCATLG.

Default values for DISP vary, depending on the utility and the data set that is being allocated. Defaults for restarted utilities also differ from default values for new utility executions. Default values are shown in the following tables.

The following table shows the data dispositions for dynamically allocated data sets for new utility executions.

Note: It is possible that output from utilities that use piped data would not be dynamically allocated for new utility executions.

Table 119. Data dispositions for dynamically allocated data sets for new utility executions

ddname	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSREC	Ignored	Ignored	Ignored	Ignored	OLD KEEP KEEP	Ignored	Ignored	Ignored	NEW CATLG CATLG	NEW CATLG CATLG
SYSDISC	Ignored	Ignored	Ignored	Ignored	NEW CATLG CATLG	Ignored	Ignored	Ignored	NEW CATLG CATLG	Ignored
SYSPUNCH	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	NEW CATLG CATLG	NEW CATLG CATLG
SYSCOPY	Ignored	Ignored	NEW CATLG CATLG	Ignored	NEW CATLG CATLG	NEW CATLG CATLG	Ignored	Ignored	NEW CATLG CATLG	Ignored
SYSCOPY2	Ignored	Ignored	NEW CATLG CATLG	Ignored	NEW CATLG CATLG	NEW CATLG CATLG	Ignored	Ignored	NEW CATLG CATLG	Ignored
SYSRCPY1	Ignored	Ignored	NEW CATLG CATLG	Ignored	NEW CATLG CATLG	NEW CATLG CATLG	Ignored	Ignored	NEW CATLG CATLG	Ignored
SYSRCPY2	Ignored	Ignored	NEW CATLG CATLG	Ignored	NEW CATLG CATLG	NEW CATLG CATLG	Ignored	Ignored	NEW CATLG CATLG	Ignored
SYSUT1	NEW DELETE CATLG	NEW DELETE CATLG	Ignored	Ignored	NEW DELETE CATLG	Ignored	NEW DELETE CATLG	NEW CATLG CATLG	NEW DELETE CATLG	Ignored
SORTOUT	NEW DELETE CATLG	Ignored	Ignored	Ignored	NEW DELETE CATLG	Ignored	Ignored	NEW DELETE CATLG	NEW DELETE CATLG	Ignored
SYSMAP	Ignored	Ignored	Ignored	Ignored	NEW CATLG CATLG	Ignored	Ignored	Ignored	Ignored	Ignored
SYSERR	NEW CATLG CATLG	Ignored	Ignored	Ignored	NEW CATLG CATLG	Ignored	Ignored	Ignored	Ignored	Ignored
FILTERDDS	Ignored	Ignored	NEW DELETE DELETE	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored

The following table shows data dispositions for dynamically allocated data sets on RESTART.

Table 120. Data dispositions for dynamically allocated data sets on RESTART

ddname	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSREC	Ignored	Ignored	Ignored	Ignored	OLD KEEP KEEP	Ignored	Ignored	Ignored	MOD CATLG CATLG	MOD CATLG CATLG
SYSDISC	Ignored	Ignored	Ignored	Ignored	MOD CATLG CATLG	Ignored	Ignored	Ignored	MOD CATLG CATLG	Ignored

Table 120. Data dispositions for dynamically allocated data sets on RESTART (continued)

ddname	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSPUNCH	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	MOD CATLG CATLG	MOD CATLG CATLG
SYSCOPY	Ignored	Ignored	MOD CATLG CATLG	Ignored	MOD CATLG CATLG	MOD CATLG CATLG	Ignored	Ignored	MOD CATLG CATLG	Ignored
SYSCOPY2	Ignored	Ignored	MOD CATLG CATLG	Ignored	MOD CATLG CATLG	MOD CATLG CATLG	Ignored	Ignored	MOD CATLG CATLG	Ignored
SYSRCPY1	Ignored	Ignored	MOD CATLG CATLG	Ignored	MOD CATLG CATLG	MOD CATLG CATLG	Ignored	Ignored	MOD CATLG CATLG	Ignored
SYSRCPY2	Ignored	Ignored	MOD CATLG CATLG	Ignored	MOD CATLG CATLG	MOD CATLG CATLG	Ignored	Ignored	MOD CATLG CATLG	Ignored
SYSUT1	MOD DELETE CATLG	MOD DELETE CATLG	Ignored	Ignored	MOD DELETE CATLG	Ignored	MOD DELETE CATLG	MOD CATLG CATLG	MOD DELETE CATLG	Ignored
SORTOUT	MOD DELETE CATLG	Ignored	Ignored	Ignored	MOD DELETE CATLG	Ignored	Ignored	MOD DELETE CATLG	MOD DELETE CATLG	Ignored
SYSMAP	Ignored	Ignored	Ignored	Ignored	MOD CATLG CATLG	Ignored	Ignored	Ignored	Ignored	Ignored
SYSERR	MOD CATLG CATLG	Ignored	Ignored	Ignored	MOD CATLG CATLG	Ignored	Ignored	Ignored	Ignored	Ignored
FILTERDDS	Ignored	Ignored	NEW DELETE DELETE	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored

LIMIT
Specifies template switching.

n Specifies the maximum primary allocation quantity that is permitted using this TEMPLATE.

CYL
Cylinders

GB Gigabytes

MB Megabytes

new_template
Specifies a character string that specifies the name of a TEMPLATE to use if the size limit is exceeded.

DB2 supports the LIMIT keyword only on TEMPLATE control statements reference by COPYDDN or RECOVERYDDN keywords on the following utilities:

- COPY FULL YES|NO
- COPY CONCURRENT
- COPYTOCOPY
- MERGECOPY
- LOAD
- REORG

Restriction:

- You cannot switch to a DD card.
- The template control statement that LIMIT references must exist in SYSIN or SYSTEMPL and it cannot refer to itself.
- Switching can only be performed a single time per allocation. Multiple switching cannot take place.
- The utility PREVIEW function ignores the LIMIT keyword, only the original TEMPLATE control statement is previewed. The LIMIT keyword is ignored for new templates.

TIME
Specifies time used in expansion of date and time DSN variables. The default *TIME* value is determined by the TEMPLATE_TIME subsystem parameter.

Tip: Set all DB2 data sharing members to the same value.

LOCAL
Use local time at the DB2 server in the expansion of date and time in DSN variables.

UTC
Use Coordinated Universal Time (UTC) in the expansion of date and time in DSN variables.

SPACE *(primary,secondary)*
Specifies the z/OS disk space allocation parameters in the range from 1 to 1677215. If you specify *(primary,secondary)* value, these values are used instead of the DB2-calculated values. When specifying primary and secondary quantities, you must either specify both values or omit both values.

Use the MAXPRIME option to set an upper limit on the *primary* quantity.

CYL
Specifies that allocation quantities, if present, are to be expressed in cylinders and that allocation is to occur in cylinders. If SPACE CYL is specified, without *(primary, secondary)*, the DB2-calculated quantities are allocated in cylinders by using 3390 device capacities for byte conversion. If TRK and MB are omitted, CYL is the default.

TRK
Specifies that allocation quantities, if present, are to be expressed in tracks and that allocation is to occur in tracks. If SPACE TRK is specified, without *(primary,secondary)*, the DB2-calculated quantities are allocated in tracks by using 3390 device capacities for byte conversion.

MB Specifies that allocation quantities, if present, are to be expressed in megabytes, and that allocation is to occur in records. One megabyte is 1 048 576 bytes. If SPACE MB is specified, the *(primary,secondary)* quantities that are specified, or the DB2-calculated quantities, might be allocated in tracks or cylinders. Data sets with a primary or secondary allocation quantity greater than 20 MB are allocated in cylinders. Smaller data sets are allocated in tracks. The 3390 device capacities are used for TRK or CYL conversion.

PCTPRIME *integer*
Specifies the percentage of the estimated required space that is to be obtained as the primary quantity.

The default value is **100**.

Use the MAXPRIME option to set the upper limit of this value for large objects.

MAXPRIME *integer*
Specifies the maximum allowable primary space allocation, expressed in cylinders (CYL). This value constrains the *primary* space value and the PCTPRIME calculation, as well as the size of each secondary allocation.

NBRSECND *integer*
Specifies the division of secondary space allocations. After the primary space is allocated, an amount of space equal to the estimated required space is divided into the specified number of secondary allocations. Individual utilities might request larger secondary extents to compensate for localized uncertainty in the space estimations.

The integer value must be in the range from 1 to 10. The default value is **10**.

DIR *integer*
Specifies the number of 256-byte records that are to be allocated for the directory of a new partitioned data set. You must specify this operand if you are allocating a new partitioned data set.

If the template is being used in a UNLOAD statement with BLOBF, CLOBF, or DBCLOBF and you specify a DSNTYPE of LIBRARY or PDS, but do not specify DIR, DB2 calculates the number of 256-byte records to allocate by dividing the estimated number of records by 20.

DSNTYPE

Specifies the type of data set to be allocated.

LIBRARY
Specifies that a partitioned data set extended (PDSE) is to be allocated.

PDS
Specifies that a partitioned data set (PDS) is to be allocated.

HFS
Specifies that a hierarchical file system (HFS) file is to be allocated.

NULL
Specifies a null file. Use this value for a template with UNLOAD CLOBF, BLOBF, or DBCLOBF to unload a null LOB value. In this case, the unload data set contains a null file name.

BASIC
Specifies a basic format data set. No more than 65535 tracks can be allocated.

LARGE
Specifies a large format data set. Greater than 65535 tracks can be allocated.

EXTREQ
Specifies an extended format data set is required.

EXTPREF
Specifies an extended format data set is preferred.

If you omit DSNTYPE, the type of data set is determined by other data set attributes, the data class for the data set, or an installation default.

EATTR
Specifies that the data set can support extended attributes.

STACK
Specifies whether output data sets are to be stacked contiguously on the same tape volumes.

NO Specifies that output data sets are not to be stacked contiguously on tape.

YES
Specifies that similar output data sets are to be stacked as successive files on one logical tape volume, where a logical tape volume can consist of a multi-volume aggregate. Within one utility execution, output data sets are stacked on a logical tape volume of the same usage type. For example, local primary image copies are stacked separately from local backup image copies.

Related information:

"Guidelines for templates and tape data sets" on page 809

TRTCH
Specifies the track recording technique for magnetic tape drives that have improved data recording capability.

NONE
Specifies that the TRTCH specification is to be eliminated from dynamic allocation.

COMP
Specifies that data is to be written in compacted format.

NOCOMP
Specifies that data is to be written in standard format.

PATH
Specifies a z/OS UNIX file path name, which can be the name of a Unix System Services (USS) pipe, an HFS file, or a zFS file.

Restrictions:

- If you specify PATH for a template, the utility that uses that template cannot be restarted.
- You can use a template with PATH only for input data sets for the LOAD utility (as indicated by the INDDN option) and for output data sets for the UNLOAD utility (as indicated by the UNLDDN option). You cannot use these templates for DISCARDDN data sets for the LOAD and REORG utilities.

When you specify PATH, adhere to the following requirements:

- Specify the path name in SBCS EBCDIC format.
- Do not specify a path name that is longer than 255 bytes.
- If the path name contains blanks, enclose it in single quotes.
- If you specify PATH and do not specify FILEDATA(RECORD), specify values for LRECL and RECFM.

FILEDATA
Specifies the content type of the z/OS UNIX file that is specified for the PATH option. Valid values are TEXT, BINARY, and RECORD. RECORD indicates that the file contains both binary and text data.

The default value is RECORD.

PATHOPTS
Specifies the access and status for the z/OS UNIX file that is specified for the PATH option.

You can specify one or more of the following z/OS options for PATHOPTS:

- ORDONLY
- OCREAT
- OWRONLY
- ONONBLOCK

For information about these options, see PATHOPTS Parameter (MVS JCL Reference).

The default for LOAD is ORDONLY. The default for UNLOAD is OCREAT, OWRONLY.

PATHMODE
Specifies the file mode of the HFS file that is specified in the PATH option.

You can specify one or more of the following z/OS options for PATHMODE:

- SIRUSR
- SIWUSR
- SIXUSR
- SIRWXU
- SIRGRP
- SIWGRP
- SIXGRP
- SIRWXG
- SIROTH
- SIWOTH
- SIXOTH
- SIRWXO

For information about these options, see PATHMODE Parameter (MVS JCL Reference).

The default value is SIRUSR.

PATHDISP
Specifies the disposition of the z/OS UNIX file that is specified for the PATH option.

You must specify two parameters for the PATHDISP:

- The first parameter specifies whether the file is to be kept or deleted when the job ends normally.
- The second parameter specifies whether the file is to be kept or deleted when the job ends abnormally.

The valid values for each parameter are KEEP or DELETE.

The default value is KEEP, KEEP.

Related reference:

TEMPLATE TIME field (TEMPLATE_TIME subsystem parameter) (DB2 Installation and Migration)

DD statement (MVS JCL Reference)

Related information:

- DSNTYPE Parameter (MVS JCL Reference)
- EATTR Parameter (MVS JCL Reference)

Before running TEMPLATE

Some DB2 utilities produce data sets during execution. These data sets are referenced in utility control statements by a set of DD name keywords and are specified in the corresponding JCL. Alternatively, you can use the TEMPLATE utility control statement to dynamically allocate utility data sets.

Options of the TEMPLATE utility allow you to specify the following information:
- The data set naming convention
- DFSMS parameters
- Disk or tape allocation parameters

You can specify a template in the SYSIN data set, immediately preceding the utility control statement that references it, or in one or more TEMPLATE libraries.

A TEMPLATE library is a data set that contains only TEMPLATE utility control statements. You can specify a TEMPLATE data set DD name by using the TEMPLATEDD option of the OPTIONS utility control statement. This specification applies to all subsequent utility control statements until the end of input or until DB2 encounters a new OPTIONS TEMPLATEDD(*ddname*) specification.

Any template that is defined within SYSIN overrides another template definition of the same name in a TEMPLATE data set.

TEMPLATE utility control statements enable you to standardize data set allocation and the utility control statements that reference those data sets, which reduces the need to customize and alter utility job streams.

Concurrency and compatibility for TEMPLATE

The TEMPLATE utility has certain concurrency and compatibility characteristics associated with it.

TEMPLATE is a control statement that is used to set up an environment for another utility to follow. The template is stored until it is referenced by a specific utility. The list is expanded when it is referenced by another utility. At that time, the concurrency and compatibility restrictions of that utility apply, and the catalog tables that are necessary to expand the list must be available for read-only access.

Key TEMPLATE operations

A TEMPLATE control statement performs a setup operation in preparation for use by another utility. Information is saved under the template name for the duration of the job step. For most utilities, you can reference the information by substituting the template name for the DD name.

If a DD name and a TEMPLATE name conflict, the DD statement is used for allocation, and the TEMPLATE is ignored. Minimally, a TEMPLATE statement consists of a name (similar to a DD name) and a data set naming convention. If nothing else is specified, DB2 calculates the required data set size and uses default

data set attributes that are appropriate to the data set that is being created. DB2 then allocates a disk data set with these defaults.

The required TEMPLATE statement might look something like the following TEMPLATE statement:

```
TEMPLATE tmp1  DSN(DB2.&TS..D&JDATE..COPY&ICTYPE.&LOCREM.&PRIBAC.)
    VOLUMES(vol1,vol2,vol3)
LISTDEF payroll INCLUDE TABLESPACE PAYROLL.*
                INCLUDE INDEXSPACE PAYROLL.*IX
                EXCLUDE TABLESPACE PAYROLL.TEMP*
                EXCLUDE INDEXSPACE PAYROLL.TMPIX*
COPY LIST payroll  COPYDDN(tmp1,tmp1) RECOVERYDDN(tmp1,tmp1)
```

Database administrators can check utility control statements without executing them by using the PREVIEW function. In PREVIEW mode, DB2 expands all TEMPLATE data set names in the SYSIN DD, in addition to any data set name from the TEMPLATE DD that are referenced on a utility control statement. DB2 then prints the information to the SYSPRINT data set and halts execution. You can specify PREVIEW in one of two ways, either as a JCL PARM or on the OPTIONS PREVIEW utility control statement.

Choosing data set names

The data set naming convention that is specified on the DSN option of each TEMPLATE statement must be appropriate for the data set that is being created. The data set naming convention must also be coordinated with the other templates and DD statements in the same job step.

About this task

The data set name must be both unique and meaningful. DB2 does not check that the data set names are unique until the execution of the utility that references the template. Ensure that the data set names are unique when you define the data set naming convention on the TEMPLATE control statement.

Procedure

To choose a data set name, apply the following guidelines:

- Use a combination of static characters, national characters, and the provided variable names to form valid z/OS data set qualifiers. Normal z/OS rules apply. Variables that produce numeric values must be preceded by either a static character or a character variable. All qualifiers must start with an alphabetic character. The qualifiers must consist of a maximum of eight characters and a maximum of 44 characters for the entire data set name. To help comply with this 44 character limit, you can use variable substring notation.
- Use the two-character form of the DSN variables to save space.
- Use two consecutive periods following all variables that precede the last qualifier (one to terminate the variable, followed by a second static period to separate the qualifiers), as in the following example:

  ```
  &DB..&TS.
  ```
- Use &DB. and &TS. to relate the data set to a database object.
- Use &PART. when executing PARTLEVEL lists. Preceed the variable with a static character or a character variable to form a valid qualifier.
- Use &JO. and &ST. to eliminate conflicts with other jobs or job steps.

- Use &SS., &US., &UT., and &UN. if you have a need to know the subsystem, member, user, utility ID, or name of the utility that produced the data set.
- Use &DATE. and &TIME. or the shorter substring variations to guarantee uniqueness. Preceed the variable with a static character or a character variable to form a valid qualifier.
- Use &IC., &LR., and &PB. to identify image copy data sets. For example, the following template name would make a meaningful seven-character data set qualifier:

  ```
  COPY&IC.&LR.&PB.
  ```
- Use &DS for FlashCopy image copies for uniqueness when copying table spaces or index spaces at the space level.

What to do next

You can check the data set names by using the PREVIEW function. In PREVIEW mode, DB2 expands all TEMPLATE data set names in the SYSIN DD, in addition to any data set name from the TEMPLATE DD that are referenced on a utility control statement. DB2 then prints the information to the SYSPRINT data set and halts execution. You can specify PREVIEW in one of two ways, either as a JCL PARM or on the OPTIONS PREVIEW utility control statement.

Related reference:

"Syntax and options of the TEMPLATE control statement" on page 789

"Syntax and options of the OPTIONS control statement" on page 407

Default space calculations for data set templates

DB2 calculates the space for data sets that are defined by the TEMPLATE utility based on the utility that is using the template. For disk data sets, all of this space is allocated as a primary quantity by default.

Data set size

For disk data sets, DB2 estimates the size of the data set based on formulas that vary according to the utility and the data set. These space estimation formulas are shown in the "Data sets that *utility* uses" topics for each online utility. Alternatively, you can specify your own values for disk space by using the SPACE option in the TEMPLATE utility control statement.

DB2 usually estimates the size of a data set based on the size of other existing data sets. However, if any of the required data sets are on tape, DB2 is unable to estimate the size.

When DB2 is able to calculate size, it calculates the maximum size. This action can result in overly large data sets. DB2 always allocates data set size with the RLSE (release) option so that unused space is released on deallocation. However in some cases, the calculated size of required data sets is too large for the DYNALLOC interface to handle. In this case, DB2 issues error message DSNU1034I, and you must allocate the data set by a DD statement. If the object is part of a LISTDEF list, you might need to remove it from the list and process it individually.

Recommendation: To improve the accuracy of the default space estimation, run the RUNSTATS utility with the UPDATE SPACE or UPDATE ALL option before you run any of the following utilities:

- CHECK DATA

- CHECK INDEX
- CHECK LOB
- REBUILD INDEX
- REORG INDEX
- REORG TABLESPACE
- UNLOAD

Extent allocation for disk data sets

By default, for data sets on disk, 100 percent of the required space that is estimated by DB2 is allocated as a primary quantity. If this amount of space is typically not available on a single volume, specify the PCTPRIME option with a value lower than 100. Alternatively, if you want the upper limit of the primary quantity based on size instead of percentage, use the MAXPRIME option.

After the primary space is allocated, a secondary quantity that is equal to the estimated required space is divided into the specified number of secondary extents. This number is identified by the NBRSECND option. Individual utilities might request larger secondary extents to compensate for localized uncertainty in the space estimations. If you specify either PCTPRIME or MAXPRIME, any secondary allocation requests are limited to the size of the primary allocation.

Related reference:

"Syntax and options of the TEMPLATE control statement" on page 789

Chapter 33, "RUNSTATS," on page 737

Related information:

DSNU1034I (DB2 Messages)

Guidelines for templates and tape data sets

When you use the TEMPLATE utility to allocate tape data sets, use the STACK option to control tape processing.

STACK NO specifies traditional, single-file processing. The data set is written, and the tape is rewound and repositioned or even remounted. STACK YES specifies that successive files are to be written on a single logical tape without repositioning or remounting.

When you specify STACK YES, DB2 has the following behavior:

- DB2 stacks files only within a single utility invocation. When that utility ends, the stack is terminated, which means that the tape is rewound and unloaded. To allow more stacking, use the LISTDEF utility to define a list and then specify that list in another utility control statement. Using a LISTDEF list forces multiple objects to be processed under a single utility invocation.
- To preserve parallel processing, parallel tasks are written to different tape volumes. The specific volume to which the data set is written can vary, depending on the following factors:
  - The number of output data sets that are being produced
  - The number of parallel processes that are requested
  - The number of tape units that are available to the job step

If you specify STACK YES, take the following actions as needed:

- To avoid issues with mounting a tape volume on the wrong drive, specify UNCNT 1.
- To prevent conflicts between parallel processes, use a single process to write a file to a stack. (Parallel processing can complicate stacking.)
- Ensure that only files of the same type are stacked on the same tape. For example, one tape might contain local primary image copies whereas another tape might contain remote primary image copies. The file types cannot be mixed.

Restrictions: Do not use the STACK YES option in the following situations:

- For concurrent copies (copies that are made by the COPY utility with the CONCURRENT option)
- For inline image copies that are created by REORG TABLESPACE on a partition-by-growth base table space with one or more LOB columns

The data sets and utilities for which the STACK YES option are supported are listed in the following table. "Yes" indicates that the specified utility supports tape stacking for the specified data set. "No" indicates that the specified utility does not support tape stacking for the specified data set. "Ignored" indicates that the specified data set does not apply to the specified utility.

Table 121. Supported data sets for tape stacking

ddname	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSREC	Ignored	Ignored	Ignored	Ignored	No	Ignored	Ignored	Ignored	Yes	Yes
SYSDISC	Ignored	Ignored	Ignored	Ignored	No	Ignored	Ignored	Ignored	Yes	Ignored
SYSPUNCH	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Yes	Yes
SYSCOPY	Ignored	Ignored	Yes	Yes	No	Yes	Ignored	Ignored	Yes	Ignored
SYSCOPY2	Ignored	Ignored	Yes	Yes	No	Yes	Ignored	Ignored	Yes	Ignored
SYSRCPY1	Ignored	Ignored	Yes	Yes	No	Yes	Ignored	Ignored	Yes	Ignored
SYSRCPY2	Ignored	Ignored	Yes	Yes	No	Yes	Ignored	Ignored	Yes	Ignored
SYSUT1	No	No	Ignored	Ignored	No	Ignored	No	No	No	Ignored
SORTOUT	No	Ignored	Ignored	Ignored	No	Ignored	Ignored	No	No	Ignored
SYSMAP	Ignored	Ignored	Ignored	Ignored	No	Ignored	Ignored	Ignored	Ignored	Ignored
SYSERR	No	Ignored	Ignored	Ignored	No	Ignored	Ignored	Ignored	Ignored	Ignored
FILTERDDS	Ignored	Ignored	No	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored

Related reference:

"Syntax and options of the TEMPLATE control statement" on page 789

Chapter 19, "LISTDEF," on page 221

How TEMPLATE supports GDG data sets

When you use the TEMPLATE utility, you can specify both absolute version references and relative references to generation data groups (GDGs) in the DSN name operand.

The first time that the data set is referenced, DB2 detects the absence of a GDG base. When (+1) or some other parenthetical relative expression is used, DB2 creates the GDG base. By default, the new base has a limit of 99 entries. Use the GDGLIMIT keyword to alter this value or prohibit this action.

After the base is created, you can specify either the absolute version `G0000V00` or a relative version. If you use the PREVIEW function on the OPTIONS utility control statement, DB2 displays the GDG relative version references. GDG names are restricted to 35 characters.

A model data set, as defined in the MODELDCB option, might be required to allocate GDG data sets in your environment.

Related reference:

"Syntax and options of the TEMPLATE control statement" on page 789

"Syntax and options of the OPTIONS control statement" on page 407

Template switching

Template switching is most commonly used to direct small data sets to disk and large data sets to tape, but it can also be used to switch to templates that differ in DSNs or in HSN classes. The decision to switch is made based on the estimated output data set size, which may differ from the actual final size of the output data set. This difference is particularly true for incremental image copies that are estimated at 10% of the space required for a full image copy.

Termination or restart of TEMPLATE

You can terminate and restart a TEMPLATE utility job.

You can terminate a TEMPLATE utility job by using the **TERM UTILITY** command if you submitted the job or have SYSOPR, SYSCTRL, or SYSADM authority.

You can restart a TEMPLATE utility job, but it starts from the beginning again.

If you are restarting this utility as part of a larger job in which TEMPLATE completed successfully, but a later utility failed, see the information about restarting utilities with templates.

Related concepts:

"How utilities restart with templates" on page 57

Related tasks:

"Restarting an online utility" on page 52

Sample TEMPLATE control statements

Use the sample control statements as models for developing your own TEMPLATE control statements.

Example 1: Specifying a basic template for an image copy on disk

The following TEMPLATE utility control statement defines a basic template that can be used to allocate an image copy data set. The name of the template is COPYDS. Any subsequent COPY jobs that specify this template for dynamically allocated data sets use the data set naming convention that is defined by the DSN option.

```
TEMPLATE COPYDS DSN &DB..&TS..COPY&IC.&LR.&PB..D&DATE..T&TIME.
```

Example 2: Using variable substring notation to specify data set names

The following control statement defines template CP2. Variable substring notation is used in the DSN option to define the data set naming convention.

Assume that in the year 2003 you make a full image copy of partition 00004 of table space DSN8S81D. Assume that you specify the template CP2 for the data set for the local primary copy. DB2 gives the following name to the image copy data set: DH173001.DSN8S81D.Y03.COPYLP.P004

Notice that every variable in the DSN option begins with an ampersand (&) and ends with a period (.). These ampersands and periods are not included in the data set name. Only periods that do not signal the end of a variable are included in the data set name.

```
TEMPLATE CP2 DSN 'DH173001.&SN..Y&YEAR(3)..COPY&LR.&PB..P&PART(3,3).'
    UNIT(SYSDA)
```

Example 3: Using COPY with TEMPLATE with variable substring notation

The following TEMPLATE utility control statement defines template SYSCOPY. Variable substring notation is used in the DSN option to define the data set naming convention. The subsequent COPY utility control statement specifies that DB2 is to make a local primary copy of the first partition of table space DSN8D81A.DSN8S81E. COPY is to write this image copy to a data set that is dynamically allocated according to the SYSCOPY template. In this case, the resulting data set name is DSN8D81A.DSN8S81E.P001

```
TEMPLATE SYSCOPY DSN '&DB..&TS..P&PA(3).'

COPY TABLESPACE DSN8D81A.DSN8S81E DSNUM 1 COPYDDN(SYSCOPY)
```

Notice that you can change the part variable in the DSN operand from P&PA(3). to P&PA(3,3). The resulting data set name is the same, because the length value of 3 is implied in the first specification.

Example 4: Specifying a template for tape data sets with an expiration date

The following control statement defines the TAPEDS template. Any data sets that are defined with this template are to be allocated on device number 3590-1, as indicated by the UNIT option, and are to expire on 1 January 2100, as indicated by the EXPDL option. The DSN option indicates that these data set names are to have the following three parts: database name, table space name, and date.

```
TEMPLATE TAPEDS DSN(&DB..&TS..D&DATE.)
    UNIT 3590-1  EXPDL '2100001'
```

Example 5: Specifying a disk template that gives space allocation parameters.

The following control statement defines the DISK template. Any data sets that are defined with this template are to have 100 cylinders of primary disk space and 10 cylinders of secondary disk space, as indicated by the SPACE and CYL options. The DSN option indicates that the data set names are to have the following three parts: database name, table space name, and time.

```
TEMPLATE DISK DSN &DB..&TS..T&TIME.
    SPACE(100,10) CYL
```

Example 6: Specifying a disk template that uses a default size with constraints

The following control statement defines the DISK template. Because the SPACE option does not specify quantities for primary and secondary space allocation, DB2 calculates these values with the following constraint: the maximum allowable primary space allocation is 1000 cylinders. This constraint is indicated by the MAXPRIME option. The DSN option indicates that the data set names are to have the following three parts: database name, table space name, and time.

```
TEMPLATE DISK DSN(&DB..&TS..T&TIME.)
    SPACE CYL  MAXPRIME 1000
```

Example 7: Using TEMPLATE with LISTDEF and COPY

In the following example, the LISTDEF utility control statement defines the CPY1 list. The TEMPLATE control statement then defines the TMP1 template. The COPY utility control statement then specifies that DB2 is to make local copies of the objects in the CPY1 list. DB2 is to write these copies to data sets that are dynamically allocated according to the characteristics that are defined in the TMP1 template.

```
LISTDEF CPY1 INCLUDE TABLESPACES TABLESPACE DBA906*.T*A906*
             INCLUDE INDEXSPACES COPY YES INDEXSPACE ADMF001.I?A906*
TEMPLATE TMP1 UNIT SYSDA
              DSN (DH109006.&STEPNAME..&SN..T&TIME.)
              DISP (MOD,CATLG,CATLG)
COPY LIST CPY1 COPYDDN (TMP1) PARALLEL (2) SHRLEVEL REFERENCE
```

Parentheses for the DSN name-expression are optional.

Example 8: Use TEMPLATE to create a GDG data set

In this example, the TEMPLATE control statement defines the COPYTEMP template. The COPY utility control statement specifies that DB2 is to write a local image copy of the table space DBLT2501.TPLT2501 to a data set that is dynamically allocated according to the characteristics that are defined in the COPYTEMP template. According to the COPYTEMP template, this data set is to be named JULTU225.GDG(+1) (as indicated by the DSN option) and is to have six entries created in the GDG base (as indicated by the GDGLIMIT option). The control block information is to be the same as that in the JULTU225.MODEL data set, as indicated by the MODELDCB option.

```
//*************************************************************
//* COMMENT:   Define a model data set.                       *
//*************************************************************
//STEP1    EXEC   PGM=IEFBR14
//SYSCOPX  DD DSN=JULTU225.MODEL,DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20)),VOL=SER=SCR03,
//         DCB=(RECFM=FB,BLKSIZE=4000,LRECL=100)
//*************************************************************
//* COMMENT: GDGLIMIT(6)
//*************************************************************
//STEP2    EXEC DSNUPROC,UID='JULTU225.GDG',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSIN    DD *
   TEMPLATE COPYTEMP
            UNIT SYSDA
            DSN 'JULTU225.GDG(+1)'
            MODELDCB JULTU225.MODEL
            GDGLIMIT(6)
   COPY TABLESPACE DBLT2501.TPLT2501
        FULL YES
        COPYDDN (COPYTEMP)
        SHRLEVEL REFERENCE
/*
```

Figure 94. Example TEMPLATE and COPY statements for writing a local copy to a data set that is dynamically allocated according to the characteristics of the template.

Example 9: Using a template to copy a GDG data set to tape

In this example, the OPTIONS utility control statement causes the subsequent TEMPLATE statement to run in PREVIEW mode. In this mode, DB2 checks the syntax of the TEMPLATE statement. If DB2 determines that the syntax is valid, it expands the data set names. The OPTIONS OFF statement ends PREVIEW mode processing. The subsequent COPY utility control statement executes normally. The COPY statement specifies that DB2 is to write a local image copy of the table space DBLT4301.TPLT4301 to a data set that is dynamically allocated according to the characteristics that are defined in the COPYTEMP template. According to the COPYTEMP template, this data set is to be named JULTU243.GDG(+1) (as indicated by the DSN option) and is to be stacked on the tape volume 99543 (as indicated by the UNIT, STACK, and VOLUMES options). The data set dispositions are specified by the DISP option. The GDGLIMIT option specifies that 50 entries are to be created in a GDG base.

```
/*
//************************************************
//* COMMENT: COPY GDG DATA SET TO TAPE
//************************************************
//STEP1    EXEC DSNUPROC,UID='JULTU243.GDG',
//         UTPROC='',
//         SYSTEM='SSTR'
//SYSIN    DD *
   OPTIONS PREVIEW
   TEMPLATE COPYTEMP
            UNIT TAPE
            DSN 'JULTU243.GDG(+1)'
            VOLUMES (99543)
            GDGLIMIT(50)
            DISP(NEW,CATLG,CATLG)
            STACK YES
   OPTIONS OFF
   COPY TABLESPACE DBLT4301.TPLT4301
        FULL YES
        COPYDDN (COPYTEMP)
        SHRLEVEL REFERENCE
/*
```

Figure 95. Example job that uses OPTIONS, TEMPLATE, and COPY statements to copy a GDG data set to tape.

Example 10: Creating a template that can be used for unloading LOB objects

The TEMPLATE control statement in this example defines a template called LOBFRV. The subsequent UNLOAD statement specifies that each CLOB in the RESUME column is to be unloaded to files that are dynamically allocated according to the characteristics defined for the LOBFRV template. In this case, those files are to be partitioned data sets, as specified by the DSNTYPE option. Each data set is to have the name UNLODTEST.*database-name*.*LOB-table-space-name*.RESUME, as specified by the DSN option. The names of each CLOB PDS is written to the unload data set. By default, the unload data set is defined by the SYSREC DD statement or template.

```
TEMPLATE LOBFRV DSN 'UNLDTEST.&DB..&TS..RESUME'
                DSNTYPE(PDS) UNIT(SYSDA)

UNLOAD DATA
  FROM TABLE DSN8910.EMP_PHOTO_RESUME
  (EMPNO  CHAR(6),
   RESUME VARCHAR(255) CLOBF LOBFRV)
 SHRLEVEL CHANGE
```

Figure 96. Example job that creates a template that can be used for unloading LOB objects.

Example 11: Using template switching.

The following TEMPLATE control statement assumes that tables space SMALL.TS occupies 10 cylinders and table space LARGE.TS occupies 100 cylinders. Both COPY statements use the SMALLTP template which specifies a limit of 20 cylinders. Table space SMALL.TS is smaller than this limit so no switching is performed. The output data set for table space SMALL.TS will be allocated on UNIT=SYSALLDA. Table space LARGE.TS is larger than this limit so the template is switched to the LARGETP template. The output data set for table space LARGE.TS will be allocated on UNIT=TAPE.

```
TEMPLATE LARGETP DSN &DB..&TS..D&DA..T&TI. UNIT=TAPE
TEMPLATE SMALLTP DSN &DB..&TS..D&DA..T&TI. UNIT=SYSALLDA LIMIT( 20 CYL, LARGETP )
COPY TABLESPACE SMALL.TS COPYDDN( SMALLTP )
COPY TABLESPACE LARGE.TS COPYDDN( SMALLTP )
```

Chapter 36. UNLOAD

The UNLOAD online utility copies data from one or more source objects to one or more BSAM sequential data sets in external formats. The output records that the UNLOAD utility writes are compatible as input to the LOAD utility. Therefore, you can use this output to reload the original table or different tables.

Although the function of the UNLOAD utility is often referred to as unloading data, the data is not deleted from the source object. The utility just makes a copy of the data. That copy includes the data only; it does not include all of the pages, such as the system pages and header pages, that are included in an image copy.

The source for UNLOAD can be DB2 table spaces or DB2 image copy data sets. The source cannot be a concurrent copy or a FlashCopy image copy.

You can unload rows from an entire table space or select specific partitions or tables to unload. You can also select columns by using the field specification list. If a table space is partitioned, you can unload all of the selected partitions into a single data set. Alternatively, you can unload each partition in parallel into physically distinct data sets.

UNLOAD must be run on the system where the definitions of the table space and the table exist.

Output

UNLOAD generates an unloaded table space or partition.

Authorization required

To execute this utility, you must use a privilege set that includes one of the following authorities:

- Ownership of the tables
- SELECT privilege on the tables
- DBADM authority for the database. If the object on which the utility operates is in an implicitly created database, DBADM authority on DSNDB04 or the implicitly created database is sufficient.
- DATAACCESS authority
- SYSADM authority
- SYSCTRL authority (catalog tables only)
- SQLADM authority (catalog tables only)
- System DBADM authority (catalog tables only)
- ACCESSCTRL authority (catalog tables only)
- SECADM authority (catalog tables only)

If you use RACF access control with multilevel security and UNLOAD is to process a table space that contains a table that has multilevel security with row-level granularity, you must be identified to RACF and have an accessible valid security label. Each row is unloaded only if your security label dominates the data security label. If your security label does not dominate the data security label, the row is not unloaded, but DB2 does not issue an error message.

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Restrictions on running UNLOAD

- UNLOAD cannot be run on a table space during the period after RECOVER is run to a point in time before materialization of pending definition changes and before REORG is run to complete the point-in-time recovery process.

Execution phases of UNLOAD

The UNLOAD utility operates in these phases:

Phase Description

UTILINIT
Performs initialization.

UNLOAD
Unloads records to sequential data sets. One pass through the input data set is made. If UNLOAD is processing a table space or partition, DB2 takes internal commits. These commits provide commit points at which the utility can be restarted if the utility stops in this phase.

UTILTERM
Performs cleanup.

Related concepts:

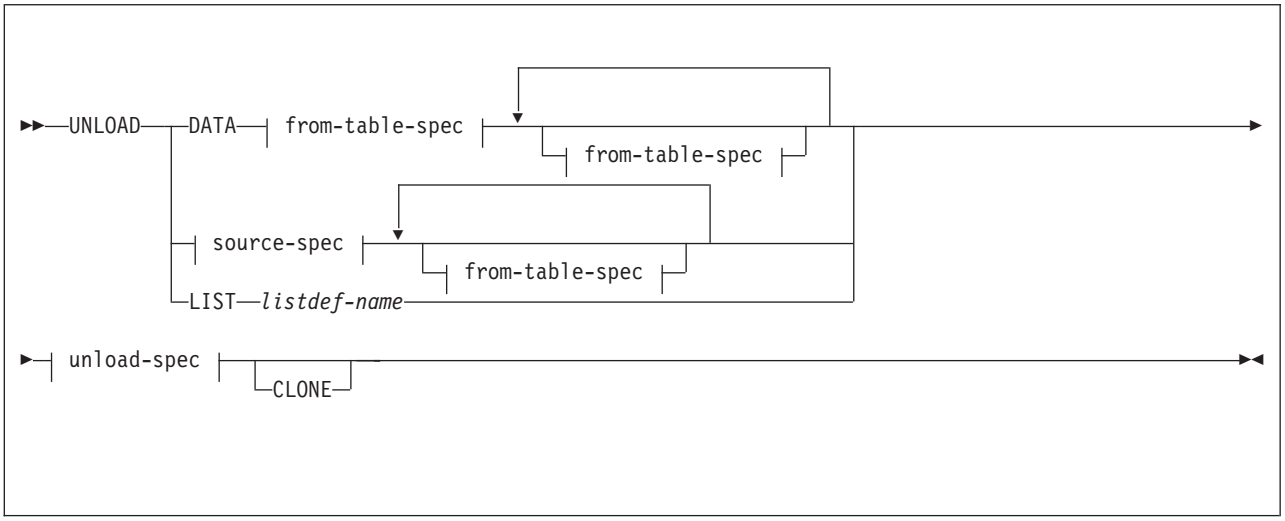
Multilevel security (Managing Security)

Syntax and options of the UNLOAD control statement

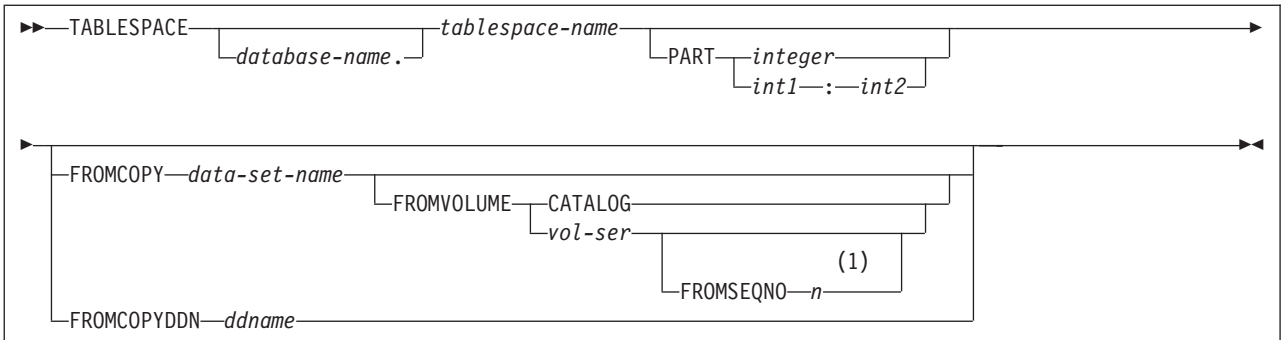
The UNLOAD utility control statement, with its multiple options, defines the function that the utility job performs.

You can create a control statement with the ISPF/PDF edit function. After creating it, save it in a sequential or partitioned data set. When you create the JCL for running the job, use the SYSIN DD statement to specify the name of the data set that contains the utility control statement.

Syntax diagram



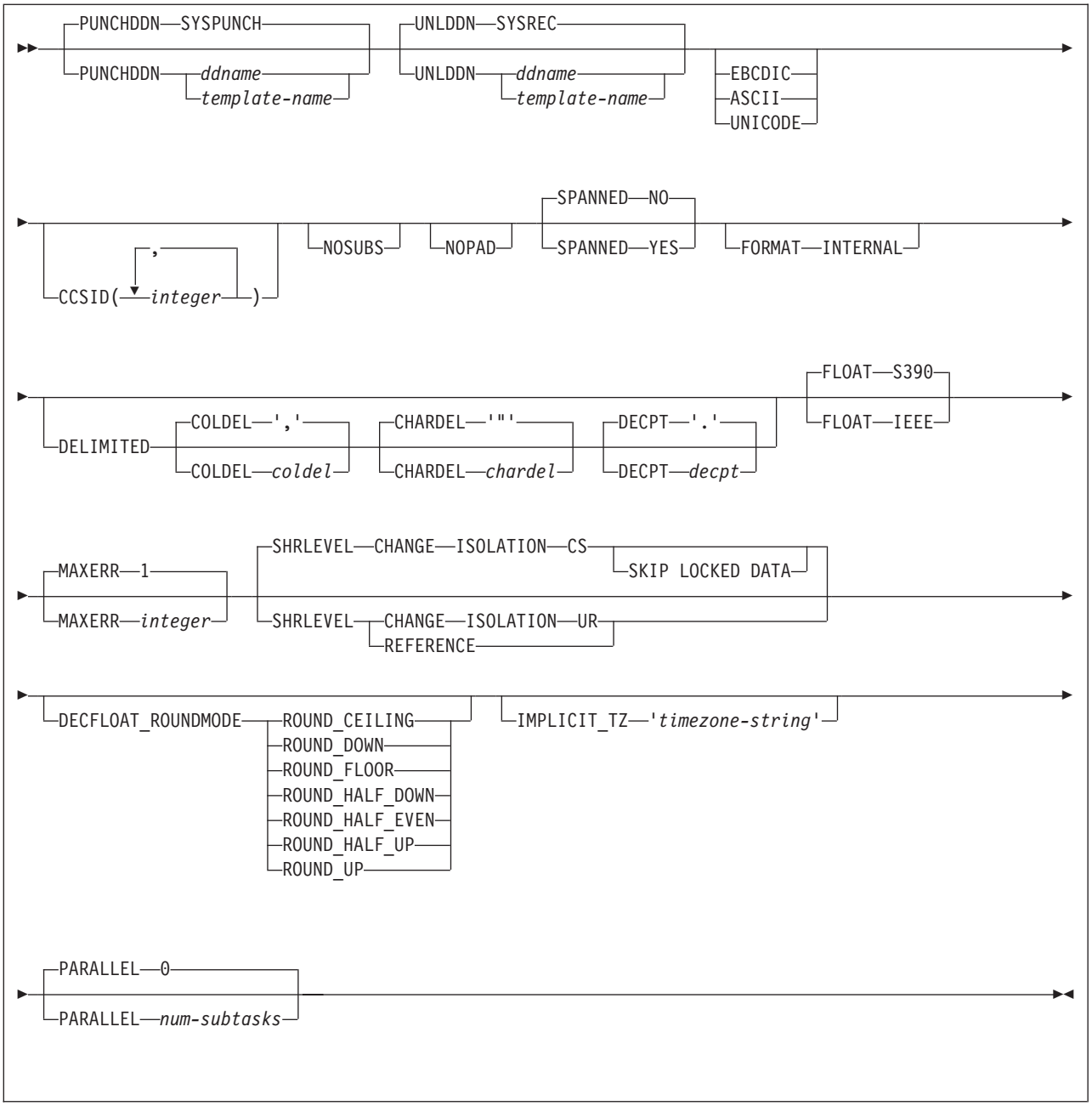
source-spec:



Notes:

1 The FROMSEQNO option is required if you are unloading an image copy from a tape data set that is not cataloged.

unload-spec:



FROM-TABLE-spec:

The syntax diagram and option descriptions for the FROM-TABLE-spec are presented in the section "FROM-TABLE-spec syntax diagram and option descriptions" on page 831.

Option descriptions

DATA

Identifies the data that is to be selected for unloading with *table-name* in the from-table-spec. The DATA keyword is mutually exclusive with TABLESPACE, PART, and LIST keywords.

When you specify the DATA keyword, or you omit either the TABLESPACE or the LIST keyword, you must also specify at least one FROM TABLE clause.

TABLESPACE
Specifies the table space (and, optionally, the database to which it belongs) from which the data is to be unloaded.

database-name
The name of the database to which the table space belongs. The name cannot be DSNDB01 or DSNDB07.

The default value is **DSNDB04**.

tablespace-name
The name of the table space from which the data is to be unloaded. The specified table space must not be a LOB or XML table space.

PART
Identifies a partition or a range of partitions from which the data is to be unloaded. This keyword applies only if the specified table space is partitioned. You cannot specify PART with LIST. The maximum is 4096.

integer
Designates a single partition. *integer* must identify an existing physical partition number within the table space.

int1:int2
Designates a range of partitions from physical partition number *int1* to physical partition number *int2*. *int1* must be a positive integer that is less than the highest partition number within the table space. *int2* must be an integer that is greater than *int1* and less than or equal to the highest partition number.

If no PART keyword is specified in an UNLOAD control statement, the data from the entire table space is unloaded into a single unload data set.

FROMCOPY *data-set-name*
Indicates that data is to be unloaded from an image copy data set. When you specify FROMCOPY, the UNLOAD utility processes only the specified image copy data set. Alternatively, you can use the FROMCOPYDDN keyword where multiple image copy data sets can be concatenated under a single DD name.

data-set-name
Specifies the name of a single image copy data set.

Related information:

"Unloading data from image copy data sets" on page 864

FROMVOLUME
Identifies the volume where the image copy data set resides.

CATALOG
Indicates that the data set is cataloged. Use this option only for an image copy that was created as a cataloged data set (which means that its volume serial is not recorded in SYSIBM.SYSCOPY).

vol-ser
Identifies the data set by an alphanumeric volume serial identifier of its first volume. Use this option only for an image copy that was created as a non-cataloged data set. To specify a data set that is stored on multiple tape volumes, identify the first *vol-ser* in the SYSCOPY record.

FROMSEQNO *n*
Identifies the image copy data set by its file sequence number. The

FROMSEQNO option is required if you are unloading an image copy from a tape data set that is not cataloged.

n Specifies the file sequence number.

FROMCOPYDDN *ddname*
Indicates that data is to be unloaded from one or more image copy data sets that are associated with the specified *ddname*. Multiple image copy data sets (primarily for the copy of pieces) can be concatenated under a single DD name.

ddname
Identifies a DD name with which one or more image copy data sets are associated.

Related information:

"Unloading data from image copy data sets" on page 864

LIST *listdef-name*
Identifies the name of a list of objects that are defined by a LISTDEF utility control statement. The list can include table spaces, index spaces, databases, a tables, an index, and partitions. The list cannot include index spaces, LOB table spaces, and directory objects. You cannot use the LIST option to specify image copy data sets.

When you specify the LIST option, the referenced LISTDEF identifies:
- The table spaces from which the data is to be unloaded. You can use the pattern-matching feature of LISTDEF.
- The partitions (if a table space is partitioned) from which the data is to be unloaded (defined by the INCLUDE, EXCLUDE, and PARTLEVEL keywords in the LISTDEF statement).

The UNLOAD utility associates a single table space with one output data set, except when partition-parallelism is activated. When you use the LIST option with a LISTDEF that represents multiple table spaces, you must also define a data set TEMPLATE that corresponds to all of the table spaces and specify the *template-name* in the UNLDDN option.

If you want to generate the LOAD statements, you must define another TEMPLATE for the PUNCHDDN data set that is similar to UNLDDN. DB2 then generates a LOAD statement for each table space. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient.

The partitions or partition ranges can be specified in a list.

PUNCHDDN
Specifies the DD name for a data set or a template name that defines one or more data set names that are to receive the LOAD utility control statements that the UNLOAD utility generates.

ddname
Specifies the DD name.

The default value is **SYSPUNCH**.

template-name
Identifies the name of a data set template that is defined by a TEMPLATE utility control statement.

If the specified name is defined both as a DD name (in the JCL) and as a template name (in a TEMPLATE statement), it is treated as the DD name.

When you run the UNLOAD utility for multiple table spaces and you want to generate corresponding LOAD statements, you must have multiple output data sets that correspond to the table spaces so that DB2 retains all of the generated LOAD statements. In this case, you must specify an appropriate template name to PUNCHDDN. If you omit the PUNCHDDN specification, the LOAD statements are not generated.

If the partition variable (&PART. or &PA.) is included in a TEMPLATE for PUNCHDDN, DB2 replaces the &PART. or &PA variable with the lowest partition number in the list of partitions to be unloaded. The partition number is in the form *nnnnn*.

UNLDDN

Specifies the DD name for a data set or a template name that defines one or more data set names into which the data is to be unloaded.

ddname

Specifies the DD name.

The default value is **SYSREC**.

template-name

Identifies the name of a data set template that is defined by a TEMPLATE utility control statement.

If the specified name is defined both as a DD name (in the JCL) and as a template name (in a TEMPLATE statement), it is treated as the DD name.

When you run the UNLOAD utility for a partitioned table space, the selected partitions are unloaded in parallel if the following conditions are true:

1. You specify a template name for UNLDDN.
2. The template data set name contains the partition as a variable (&PART. or &PA.) without substring notation. This template name is expanded into multiple data sets that correspond to the selected partitions.
3. The TEMPLATE control statement does not contain all of the following options:
   - STACK(YES)
   - UNIT(TAPE)
   - An UNCNT value that is less than or equal to one.

If conditions 1 and 2 are true, but condition 3 is false, partition parallelism is not activated and all output data sets are stacked on one tape.

DB2 cannot do parallel UNLOAD operations for partitions if you use substring notation for the partition variable (&PART. or &PA.) in the DSN argument, because the data set name might not be unique for all partitions. Therefore, DB2 sets the value of &PA to '00000', and uses a single UNLDDN data set for all partitions. This action might cause duplicate data set errors on subsequent UNLOAD jobs for other partitions of the same table space.

When you run the UNLOAD utility for multiple table spaces, the output records are placed in data sets that correspond to the respective table spaces. Therefore the output data sets must be physically distinctive, and you must specify an appropriate template name to UNLDDN. If you omit the UNLDDN specification, the SYSREC DD name is not used, and an error occurs.

If the partition variable (&PART. or &PA.) is included in the TEMPLATE DSN statement when partition parallelism is not applicable (when the source is a non-partitioned table space or an image copy), the variable is replaced by

'00000' in the actual data set name. In this case, warning message DSNU1252I is issued, and the UNLOAD utility issues return code 4.

EBCDIC
Specifies that all output data of the character type is to be in EBCDIC. If a different encoding scheme is used for the source data, the data (except for bit strings) is converted into EBCDIC.

If you do not specify EBCDIC, ASCII, UNICODE, or CCSID, the encoding scheme of the source data is preserved.

See the description of the CCSID option for this utility.

ASCII
Specifies that all output data of the character type is to be in ASCII. If a different encoding scheme is used for the source data, the data (except for bit strings) is converted into ASCII.

If you do not specify EBCDIC, ASCII, UNICODE, or CCSID, the encoding scheme of the source data is preserved.

See the description of the CCSID option for this utility.

UNICODE
Specifies that all output data of the character type (except for bit strings) is to be in Unicode. If a different encoding scheme is used for the source data, the data is converted into Unicode.

If you do not specify EBCDIC, ASCII, UNICODE, or CCSID, the encoding scheme of the source data is preserved.

See the description of the CCSID option of this utility.

CCSID*(integer1,integer2,integer3)*
Specifies up to three coded character set identifiers (CCSIDs) that are to be used for the data of character type in the output records, including data that is unloaded in the external character formats.

integer1 specifies the CCSID for SBCS data. *integer2* specifies the CCSID for mixed data. *integer3* specifies the CCSID for DBCS data. This option is not applied to data with a subtype of BIT.

If you specify both FORMAT DELIMITED and UNICODE, all output data is in CCSID 1208, UTF-8; any other specified CCSID is ignored.

The following specifications are also valid:

CCSID(*integer1***)**
Indicates that only an SBCS CCSID is specified.

CCSID(*integer1***,***integer2***)**
Indicates that an SBCS CCSID and a mixed CCSID are specified.

integer
Specifies either a valid CCSID or 0.

If you specify a value of 0 for one of the arguments or omit a value, the encoding scheme that is specified by EBCDIC, ASCII, or UNICODE is assumed for the corresponding data type (SBCS, MIXED, or DBCS).

If you do not specify EBCDIC, ASCII, or UNICODE:
- If the source data is of character type, the original encoding scheme is preserved.

- For character strings that are converted from numeric, date, time, or timestamp data, the default encoding scheme of the table is used. For more information, see the CCSID option of the CREATE TABLE statement in

If you specify EBCDIC, ASCII, or UNICODE, the CCSIDs specified for SBCS, DBCS, and MIXED must be valid CCSIDs for the specified encoding scheme, or 0.

When a CCSID conversion is requested, CCSID character substitutions can occur in the output string. Use the NOSUBS option to prevent possible character substitutions during CCSID conversion.

NOSUBS
Specifies that CCSID code substitution is not to be performed during unload processing.

When a string is converted from one CCSID to another (including EBCDIC, ASCII, and Unicode), a substitution character is sometimes placed in the output string. For example, this substitution occurs when a character (referred to as a code point) that exists in the source CCSID does not exist in the target CCSID. You can use the NOSUBS keyword to prevent the UNLOAD utility from allowing this substitution.

If you specify the NOSUBS keyword and character substitution is attempted while data is being unloaded, this action is treated as a conversion error. The record with the error is not unloaded, and the process continues until the total error count reaches the number that is specified by MAXERR.

NOPAD
Specifies that the variable-length columns in the unloaded records are to occupy the actual data length without additional padding. As a result, the unloaded or discarded records might have varying lengths. If XML columns are unloaded without the use of file reference variables, NOPAD is the default.

When you do not specify NOPAD:

- Default UNLOAD processing pads variable-length columns in the unloaded records to their maximum length, and the unloaded records have the same length for each table.
- The padded data fields are preceded by the length fields that indicate the size of the actual data without the padding.
- When the output records are reloaded with the LOAD utility, padded data fields are treated as varying-length data.

If you specify DELIMITED, the NOPAD option is the default for variable-length columns. For fixed-length columns, the normal padding rules apply.

Although LOAD processes records with variable-length columns that are unloaded or discarded by using the NOPAD option, these records cannot be processed by applications that process only fields in fixed positions. For example, the LOAD statement that is generated for the EMP sample table would look similar to the LOAD statement in Figure 65 on page 583.

SPANNED
Indicates whether records are to be unloaded into a VBS data set in spanned record format.

YES
Records are to be unloaded in spanned record format.

When you specify SPANNED YES, the source object and UNLOAD statement must satisfy the following requirements:

- The source table must have at least one XML or LOB column. If the table does not have any XML or LOB columns, SPANNED YES is ignored.
- If you specify multiple FROM TABLE statements to unload multiple tables, all tables must contain at least one LOB or XML column. Otherwise, none of the tables are unloaded in spanned record format.
- The UNLOAD statement must include a field specification list that specifies all LOB and XML data at the end of the record. The data type must be specified for the LOB and XML columns. Do not include a length or POSITION value for the LOB and XML columns. If no field specifications are included or the data type is not included in the field specification, SPANNED YES is ignored.
- Do not specify the following options with SPANNED YES:
  - DELIMITED
  - FROMCOPY or FROMCOPYDDN
  - LIST (If you specify LIST, SPANNED YES is ignored.)

In the cases where SPANNED YES is ignored, the unload data set is created with VB (variable-length blocked) record format, which does not allow records that are greater than 32 KB.

When you specify SPANNED YES, UNLOAD also takes the following actions:

- Ignores the RECFM attribute of the data set.
- Uses the NOPAD option.
- Ignores the TRUNCATE option.
- Ignores large block interface (LBI) if used by any output data sets.

If you also specify PUNCHDDN, the generated LOAD statement lists the LOB and XML data in a field specification list in the same order as the UNLOAD field specification list.

NO Records are not to be unloaded in spanned record format.

Related information:

"Unloading data in spanned record format" on page 862

Large Block Interface (LBI) (z/OS DFSMS Using Data Sets)

FORMAT INTERNAL

Specifies that the output record format is DB2 internal format. UNLOAD does no field procedure processing, data conversion, or CCSID conversion on the data. If the UNLOAD control statement contains a field specification, it is ignored.

When FORMAT INTERNAL is specified:

- UNLOAD does not unload data for LOB or XML columns. UNLOAD issues a warning message that indicates that LOB or XML data was not unloaded.
- UNLOAD does not add trailing blanks to output from variable-length columns.
- UNLOAD decompresses the data and does decoding that is specified by edit procedures.
- UNLOAD ignores any field specifications in the UNLOAD utility control statement.

Restrictions:

- Data that is unloaded with FORMAT INTERNAL should be loaded only into the same table, or into a table that exactly matches the unloaded table definition, including having the same field procedures.
- FORMAT INTERNAL cannot be specified with any of the following options:
  - ASCII
  - CCSID
  - DECFLOAT_ROUNDMODE
  - DELIMITED
  - EBCDIC
  - FLOAT
  - HEADER
  - NOPAD
  - NOSUBS
  - UNICODE

DELIMITED

Specifies that the output data file is in a delimited format. When data is in a delimited format, all fields in the output data set are character strings or external numeric values. In addition, each column in a delimited file is separated from the next column by a column delimiter character.

For each of the delimiter types that you can specify, you must ensure that the delimiter character is specified in the code page of the target data. The delimiter character can be specified as either a character or hex constant. For example, to specify # as the delimiter, you can specify either COLDEL '#' or COLDEL X'23'. If the utility statement is coded in a character type that is different from the output file, such as a utility statement that is coded in EBCDIC and output data that is in Unicode, specify the delimiter character in the utility statement as a hex constant, or the result is unpredictable.

You cannot specify the same character for more than one type of delimiter (COLDEL, CHARDEL, and DECPT).

If you specify the FORMAT DELIMITED option:

- You cannot specify HEADER CONST or use any of the multiple FROM TABLE statements.
- UNLOAD ignores any specified POSITION statements within the UNLOAD utility control statement.

For delimited output, UNLOAD does not add trailing padded blanks to variable-length columns, even if you do not specify the NOPAD option. For fixed-length columns, the normal padding rules apply. For example, if a VARCHAR(10) field contains `ABC`, UNLOAD DELIMITED unloads the field as `"ABC"`. However, for a CHAR(10) field that contains `ABC`, UNLOAD DELIMITED unloads it as `"ABC "`. For information about using delimited output and delimiter restrictions, see “Unloading delimited files” on page 873. For more information about delimited files see Appendix I, “Delimited file format,” on page 1203.

COLDEL

Specifies the column delimiter that is used in the output file. The default is a comma (,). For most ASCII and UTF-8 data, this value is X'2C', and for most EBCDIC data, this value is a X'6B'.

CHARDEL

Specifies the character string delimiter that is used in the output file. The

default is a double quotation mark ("). For most ASCII and UTF-8 data, this value is X'22', and for most EBCDIC data, this value is X'7F'.

The UNLOAD utility adds the CHARDEL character before and after every character string. To delimit character strings that contain the character string delimiter, the UNLOAD utility repeats the character string delimiter where it used in the character string. The LOAD utility then interprets any pair of character delimiters that are found between the enclosing character delimiters as a single character. For example, the phrase `what a "nice warm" day` is unloaded as `"what a ""nice warm"" day"`, and LOAD interprets it as `what a "nice warm" day`. The UNLOAD utility recognizes these character pairs for only CHAR, VARCHAR, and CLOB fields.

DECPT
Specifies the decimal point character that is used in the output file. The default is a period (.). For most ASCII and UTF-8 data, this value is X'2E', and for most EBCDIC data, this value is X'4B'.

FLOAT
Specifies the output format of the numeric floating-point data. This option applies to the binary output format only.

S390
Indicates that the binary floating point data is written to the output records in the S/390® internal format (also known as the hexadecimal floating point, or HFP).

IEEE
Indicates that the binary floating-point data is written to the output records in the IEEE format (also known as the binary floating point, or BFP).

MAXERR *integer*
Specifies the maximum number of records in error that are to be allowed; the unloading process terminates when this value is reached.

integer
Specifies the number of records in error that are allowed. When the error count reaches this number, the UNLOAD utility issues message DSNU1219 and terminates with return code 8.

The default value is **1**, which indicates that UNLOAD stops when the first error is encountered. If you specify 0 or any negative number, execution continues regardless of the number of records that are in error.

If multiple table spaces are being processed, the number of records in error is counted for each table space. If the LIST option is used, you can add OPTION utility control statement (EVENT option with ITEMERROR) before the UNLOAD statement to specify that the table space in error is to be skipped and the subsequent table spaces are to be processed.

The MAXERR option is ignored when the UNLOAD utility encounters errors that prevent it from continuing to process data. For example, if you receive message DSNU283I, SQLCODE -452, and reason code 7 when unloading LOB or XML data using file reference variables, the UNLOAD utility terminates regardless of what you specified for MAXERR.

SHRLEVEL
Specifies whether other processes can access or update the table space or partitions while the data is being unloaded.

UNLOAD ignores the SHRLEVEL specification when the source object is an image copy data set.

The default value is **SHRLEVEL CHANGE ISOLATION CS**.

CHANGE
Specifies that rows can be read, inserted, updated, and deleted from the table space or partition while the data is being unloaded.

ISOLATION
Specifies the isolation level with SHRLEVEL CHANGE.

CS Indicates that the UNLOAD utility is to read rows in cursor stability mode. With CS, the UNLOAD utility assumes CURRENTDATA(NO).

UR Indicates that uncommitted rows, if they exist, are to be unloaded. The unload operation is performed with minimal interference from the other DB2 operations that are applied to the objects from which the data is being unloaded.

SKIP LOCKED DATA
Specifies that the UNLOAD utility is to skip rows on which incompatible locks are held by other transactions. This option applies to row level or page level lock.

REFERENCE
Specifies that during the unload operation, rows of the tables can be read, but cannot be inserted, updated, nor deleted by other DB2 threads.

When you specify SHRLEVEL REFERENCE, the UNLOAD utility drains writers on the table space from which the data is to be unloaded. When data is unloaded from multiple partitions, the drain lock is obtained for all of the selected partitions in the UTILINIT phase.

DECFLOAT_ROUNDMODE
Specifies the rounding mode to be used when DECFLOATs are manipulated. The following rounding modes are supported:

ROUND_CEILING
Round toward +infinity. The discarded digits are removed if they are all zero or if the sign is negative. Otherwise, the result coefficient should be incremented by 1 (rounded up).

ROUND_DOWN
Round toward 0 (truncation). The discarded digits are ignored.

ROUND_FLOOR
Round toward -infinity. The discarded digits are removed if they are all zero or positive. Otherwise, the sign is negative and the result coefficient should be incremented by 1 (rounded up).

ROUND_HALF_DOWN
Round to the nearest number. If equidistant, round down. If the discarded digits are greater than 0.5, the result coefficient should be incremented by 1 (rounded up). The discarded digits are ignored if they are 0.5 or less.

ROUND_HALF_EVEN
Round to the nearest number. If equidistant, round so that the final digit is even. If the discarded digits are greater than .05, the result coefficient should be incremented by 1 (rounded up). The discarded digits are ignored if they are less than 0.5. If the result coefficient is .05 and the rightmost

digit is even, the result coefficient is not altered. If the result coefficient is .05 and the rightmost digit is odd, the result coefficient should be incremented by 1 (rounded up).

ROUND_HALF_UP
Round to nearest. If equidistant, round up. If the discarded digits are greater than or equal to 0.5, the result coefficient should be incremented by 1 (rounded up). Otherwise the discarded digits are ignored.

ROUND_UP
Round away from 0. If all of the discarded digits are 0, the result is unchanged. Otherwise, the result coefficient should be incremented by 1 (rounded up).

If the user does not specify DECFLOAT_ROUNDMODE, the default value of the DECFLOAT_ROUNDMODE option is DECFLOAT ROUNDING MODE from the DECP.

IMPLICIT_TZ
Specifies the implicit time zone to use when timestamp values are being unloaded from a TIMESTAMP column with no time zone, and the field specification for the column is TIMESTAMP WITH TIME ZONE EXTERNAL.

'timezone-string'
Specifies the implicit time zone value. The time zone is the difference (in hours and minutes) between local time and UTC. The range of the hour component is -12 to 14, and the minute component is 00 to 59. The time zone is specified in the form ±th:tm, with values ranging from -12:59 to +14:00.

IMPLICIT_TZ is a required keyword when the unload timestamp without time zone column to a timestamp with time zone column is used.

PARALLEL

Specifies the maximum number of subtasks that are to be used in parallel to process the unloading of a partitioned table space. If the PARALLEL keyword is omitted, the maximum number of subtasks is limited by the number of partitions being unloaded.

(*num-subtasks*)

Specifies the maximum number of subtasks that are to be processed in parallel. The value must be an integer between 0 and 32767, inclusive. If the specified value for *num-subtasks* is greater than 32767, the UNLOAD statement fails. If 0 or no value is specified for *num-subtasks*, the UNLOAD utility uses the optimal number of parallel subtasks after applying constraints. If the specified value for *num-subtasks* is greater than the calculated optimal number, the UNLOAD utility limits the number of parallel subtasks to the optimal number.

The specified number of subtasks for PARALLEL always overrides the specification of the PARAMDEG_UTIL subsystem parameter, so PARALLEL can be smaller or larger than the value of PARAMDEG_UTIL.

CLONE
Indicates that UNLOAD is to unload data from only clone tables in the specified table spaces. This utility will only process clone data if the CLONE keyword is specified. The use of CLONED YES on the LISTDEF statement is not sufficient. If you specify the name of the clone table in the FROM TABLE clause, you do not need to specify the CLONE keyword.

FROM-TABLE-spec syntax diagram and option descriptions

More than one table or partition for each table space can be unloaded with a single invocation of the UNLOAD utility. One FROM TABLE statement for each table that is to be unloaded is required to identify:

- A table name from which the rows are to be unloaded
- A field to identify the table that is associated with the rows that are to be unloaded from the table by using the HEADER option
- Sampling options for the table rows
- A list of field specifications for the table that is to be used to select columns that are to be unloaded
- Selection conditions, specified in the WHEN clause, that are to be used to qualify rows that are to be unloaded from the table

All tables that are specified by FROM TABLE statements must belong to the same table space. If rows from specific tables are to be unloaded, a FROM TABLE clause must be specified for each source table. If you do not specify a FROM TABLE clause for a table space, all the rows of the table space are unloaded.

Use a list of field specifications to specify the following characteristics:

- Column selection. Specifies the column names of a table that is to be unloaded. If a list of field specifications is given, only the listed columns are unloaded.
- Column ordering. Specifies the order of fields that are to be placed in the output records. If a list of field specifications is given, data of the listed columns is unloaded in the order of listed column names.
- Output field attributes and format. Specifies the data type, length, and format of the data in the output records.

If you omit a list of field specifications, all columns of the source table are unloaded in the defined column order for the table. The default output field types that correspond to the data types of the columns are used.

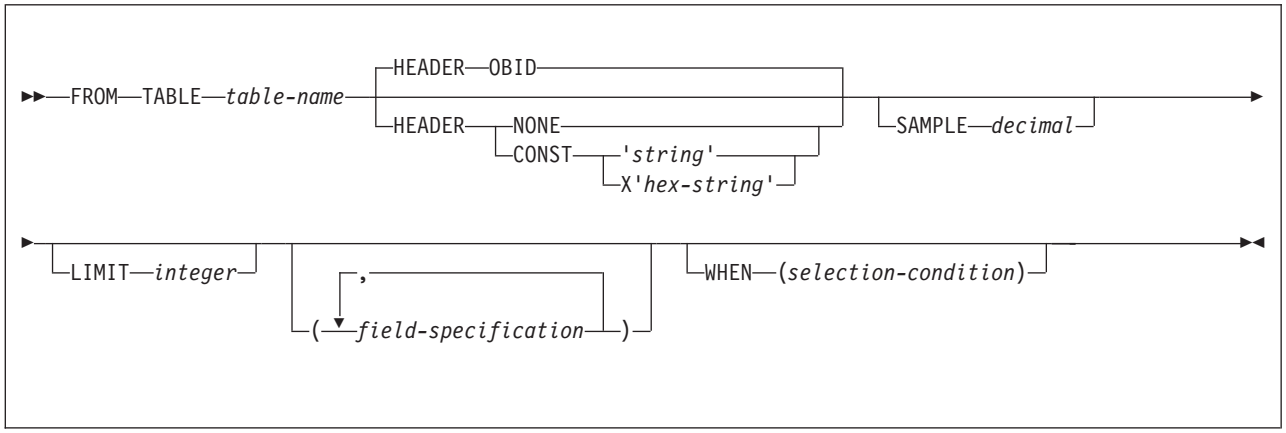
When unloading XML or LOB columns to a VBS data set, the LOB and XML values are written at the end of the record in their column definition order, as specified by the required field specification list. This order is the same order that the LOAD utility uses when reading XML and LOB values from a VBS data set.

In a FROM TABLE clause, you can use parentheses in only two situations: to enclose the entire field selection list, and in a WHEN selection clause. This usage avoids potential conflict between the keywords and field-names that are used in the field selection list. A valid sample of a FROM TABLE clause specification follows:

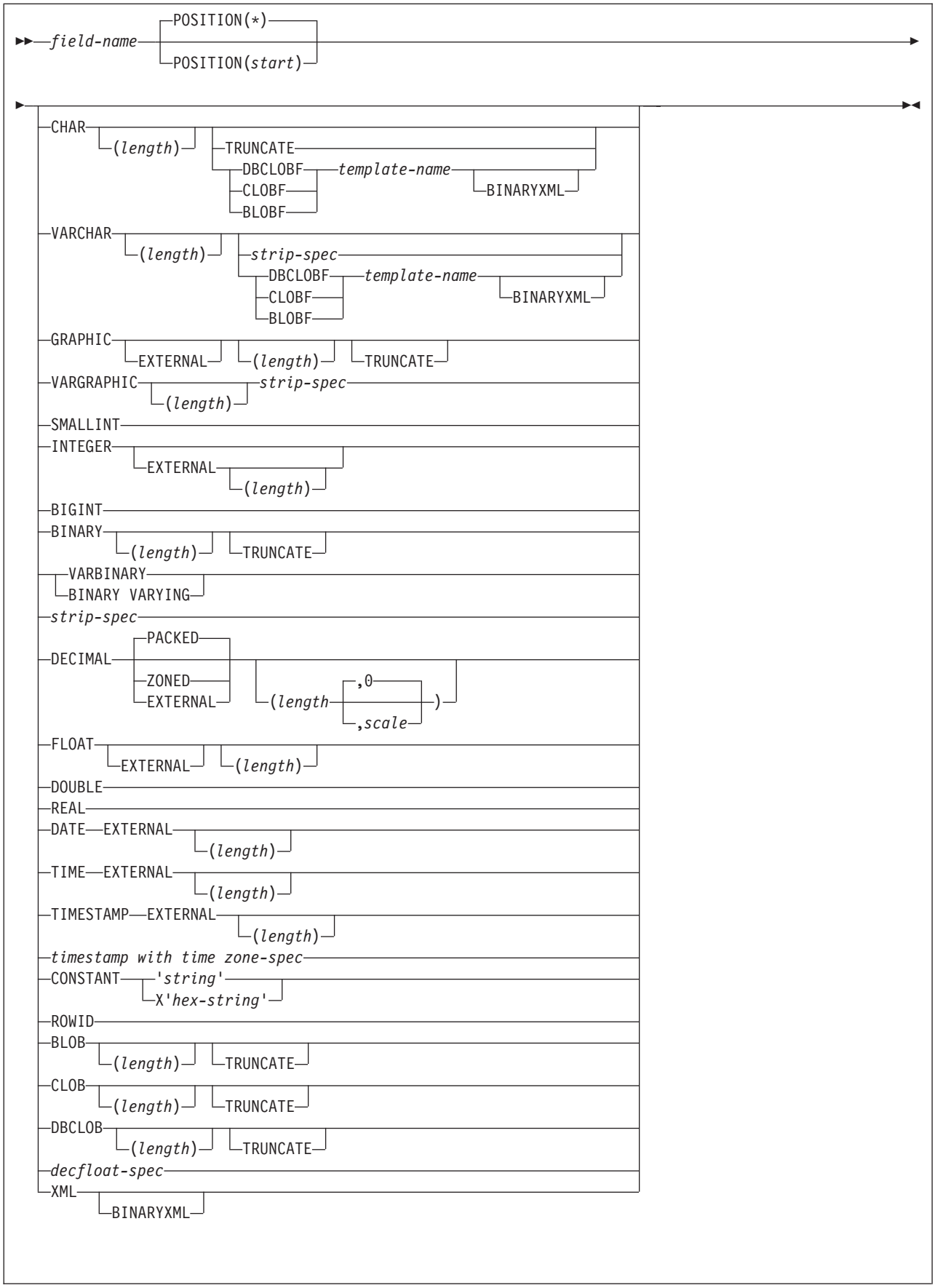
```
UNLOAD ...
  FROM TABLE tablename SAMPLE x (c1,c2) WHEN (c3>0)
```

You cannot specify FROM TABLE if the LIST option is already specified.

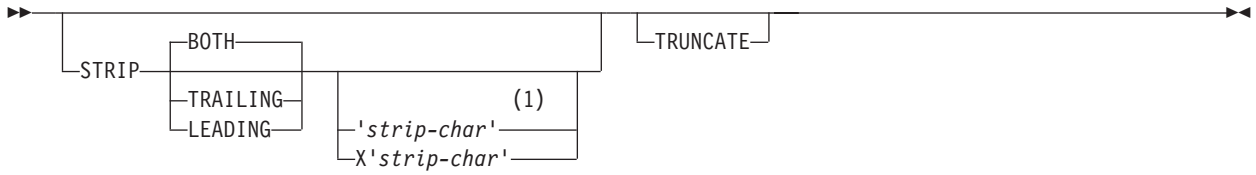
FROM-TABLE-spec



field-specification:


field-name
POSITION(*)
POSITION(start)
CHAR
(length)
TRUNCATE
DBCLOBF
CLOBF
BLOBF
template-name
BINARYXML
VARCHAR
(length)
strip-spec
DBCLOBF
CLOBF
BLOBF
template-name
BINARYXML
GRAPHIC
EXTERNAL
(length)
TRUNCATE
VARGRAPHIC
(length)
strip-spec
SMALLINT
INTEGER
EXTERNAL
(length)
BIGINT
BINARY
(length)
TRUNCATE
VARBINARY
BINARY VARYING
strip-spec
DECIMAL
PACKED
ZONED
EXTERNAL
(length
,0
,scale
)
FLOAT
EXTERNAL
(length)
DOUBLE
REAL
DATE EXTERNAL
(length)
TIME EXTERNAL
(length)
TIMESTAMP EXTERNAL
(length)
timestamp with time zone-spec
CONSTANT
'string'
X'hex-string'
ROWID
BLOB
(length)
TRUNCATE
CLOB
(length)
TRUNCATE
DBCLOB
(length)
TRUNCATE
decfloat-spec
XML
BINARYXML

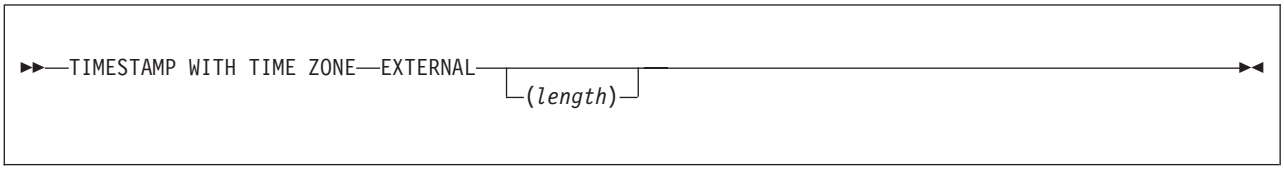
strip spec:



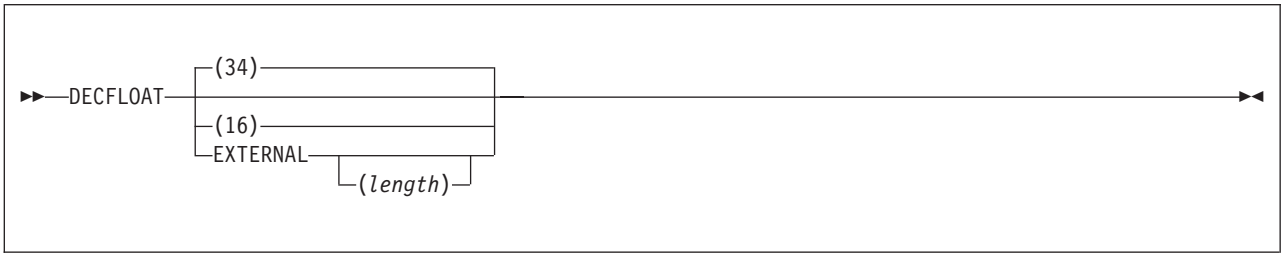
Notes:

1 If you specify VARGRAPHIC, BINARY, or VARBINARY, you cannot specify 'strip-char'. You can specify only X'strip-char'.

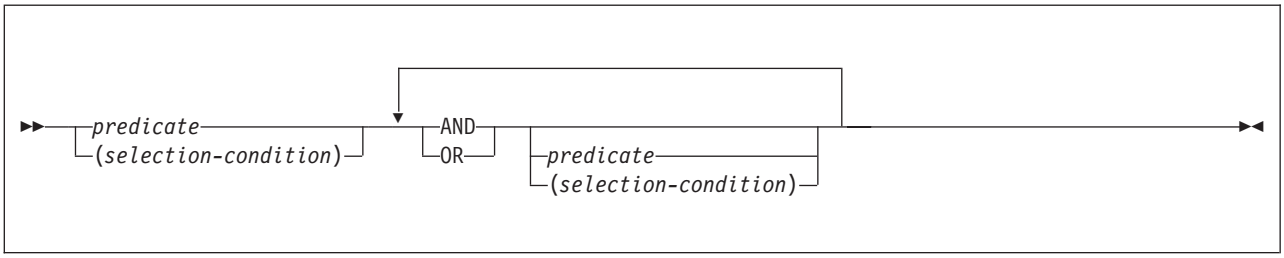
timestamp with time zone spec:



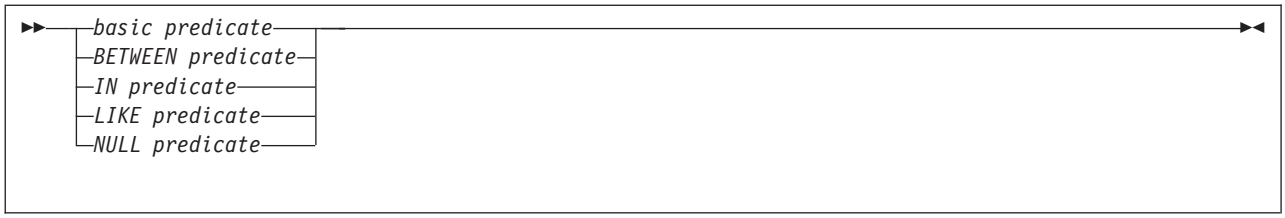
decfloat spec:



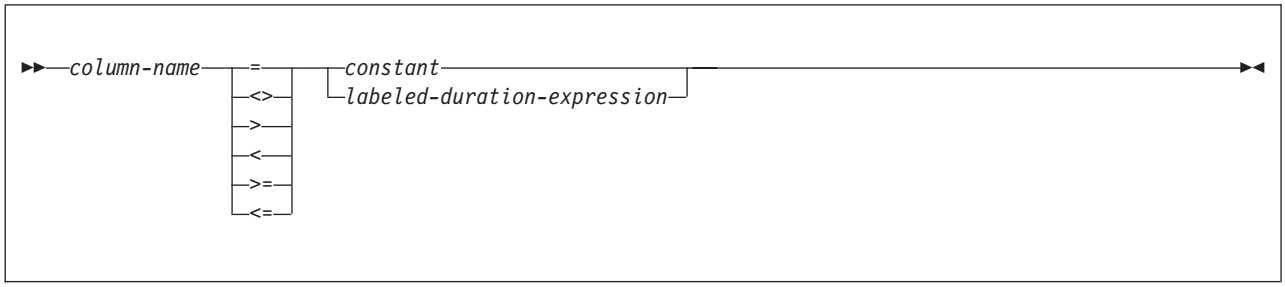
selection condition:



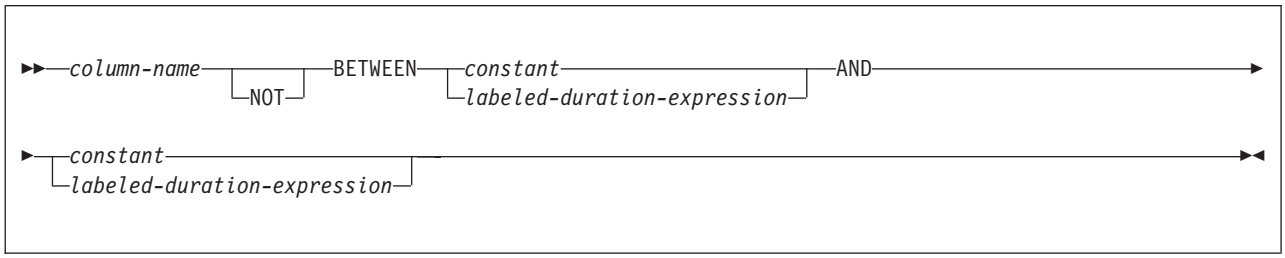
predicate:



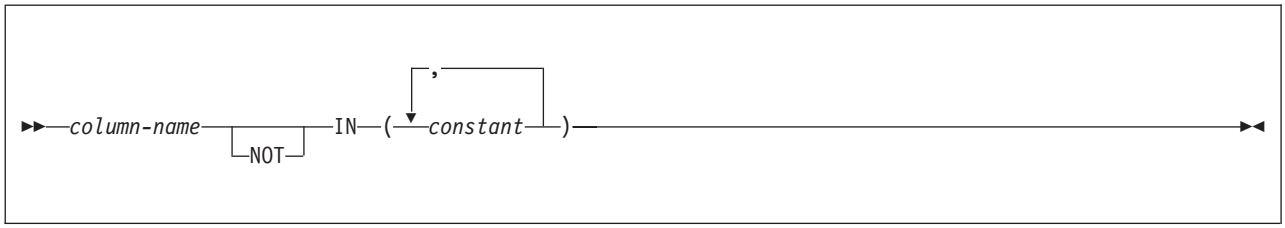
basic predicate:



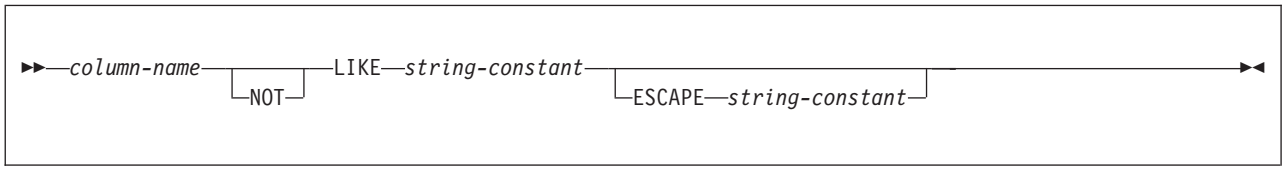
BETWEEN predicate:



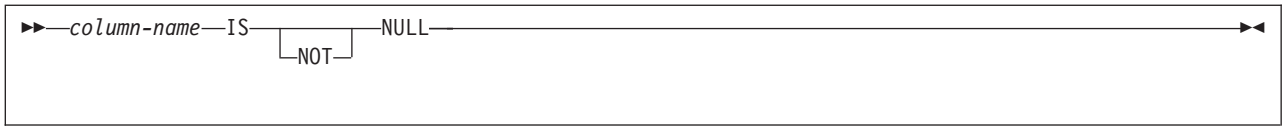
IN predicate:



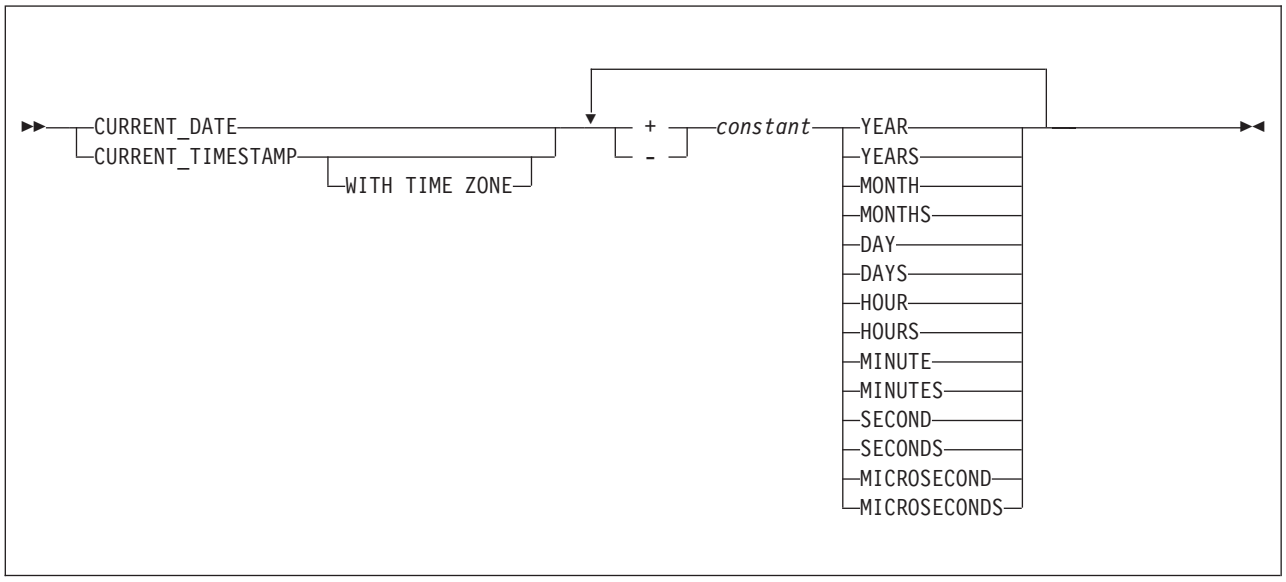
LIKE predicate:



NULL predicate:



labeled-duration-expression:



Option descriptions for FROM TABLE

table-name
Identifies a DB2 table from which the rows are to be unloaded and to which the options in the FROM TABLE clause are to be applied.

If the table name is not qualified by a schema name, the authorization ID of the invoker of the utility job step is used as the schema qualifier of the table name. Enclose the table name in quotation marks if the name contains a blank.

If you specify a dropped table on the FROM TABLE option, the UNLOAD utility terminates with return code 4.

HEADER
Specifies a constant header field, at the beginning of the output records, that can be used to associate an output record with the table from which it was unloaded.

If you specify a header field, it is used as the field selection criterion of the WHEN clause (a part of the INTO-TABLE specification) in the LOAD statement that is generated.

OBID
Specifies that the object identifier (OBID) for the table (a 2-byte binary value) is to be placed in the first 2 bytes of the output records that are unloaded from the table.

If you omit the HEADER option, **HEADER OBID** is the default, except for delimited files.

With HEADER OBID, the first 2 bytes of the output record cannot be used by the unloaded data. For example, consider the following UNLOAD statement:

```
UNLOAD ...
  FROM TABLE table-name HEADER OBID ...
```

The preceding UNLOAD statement generates a LOAD statement that is similar to the following example:

```
LOAD ...
  INTO TABLE table-name WHEN (1:2)=X'hh' ...
```

In this example, X'hh' is the hexadecimal notation of the OBID of table *table-name*.

NONE
Indicates that no record header field is to be created. HEADER NONE is the default value for a delimited file.

If HEADER NONE is specified in a FROM TABLE clause, the corresponding INTO TABLE clause in the generated LOAD statement does not have a WHEN specification. Therefore, if rows from multiple tables are unloaded and HEADER NONE is specified in one or more FROM TABLE clauses, rows that are unloaded from those tables are not able to be reloaded until you edit the generated LOAD statement. If you use the generated statement directly with the LOAD utility, the results might be unpredictable.

CONST
Specifies that a constant string is to be used as the record header. The given string operand determines the length of the header field. The string value must be enclosed by a pair of single quote characters.

For example, consider the following UNLOAD statement:

```
UNLOAD ...
  FROM TABLE table-name HEADER CONST 'abc' ...
```

The preceding UNLOAD statement generates a LOAD statement that is similar to the following example:

```
LOAD ...
  INTO TABLE table-name WHEN (1:3)='abc' ...
```

In this example, the given string is assumed to be in SBCS EBCDIC format. The output string of the HEADER field is in the specified or the default encoding scheme. If the encoding scheme that is used for output is not EBCDIC, the SBCS CCSID conversion is applied to the given string before it is placed in the output records. If the output SBCS encoding scheme is not EBCDIC, the WHEN condition in the generated LOAD statement contains a hexadecimal string.

You can also use the hexadecimal form, X'*hex-string*', to represent a string constant. If you want to specify a CONST string value in an encoding scheme other than SBCS EBCDIC, use the hexadecimal form. No CCSID conversion is performed if the hexadecimal form is used.

SAMPLE *decimal*
Indicates that only sampled rows of the table are to be unloaded. If selection conditions are specified by a WHEN clause within the same FROM TABLE clause, sampling is applied to the rows that are qualified by the WHEN selection conditions.

decimal
Specifies the percentage of the rows that are to be sampled in the decimal format. The precision is *ddd.dddd*, and the valid range is *0 <= decimal <= 100*.

If the number of rows to which the sampling is to be applied is *N*:

- *decimal* × *N* / *100* rows are unloaded. (The fraction might be rounded to the nearest whole number.)
- If *decimal* > *0* and *N* > *0*, at least one row is unloaded.
- If *decimal* = *100*, all rows from the table are unloaded.
- If the given *decimal* = *0* or *N* = *0*, no row is unloaded from the table.

The sampling is applied for each individual table. If the rows from multiple tables are unloaded with sampling enabled, the referential integrity between the tables might be lost.

LIMIT *integer*
Specifies the maximum number of rows that are to be unloaded from a table. If the number of unloaded rows reaches the specified limit, message DSNU1201 is issued for the table, and no more rows are unloaded from the table. The process continues to unload qualified rows from the other tables.

When partition parallelism is activated, the LIMIT option is applied to each partition instead of to the entire table.

integer
Indicates the maximum number of rows that are to be unloaded from a table. If the specified number is less than or equal to zero, no row is unloaded from the table.

Like the SAMPLE option, if multiple tables are unloaded with the LIMIT option, the referential integrity between the tables might be lost.

field-name
Identifies a column name that must exist in the source table.

POSITION*(start)*
Specifies the field position in the output record. You can specify

the position parameter as follows:

* An asterisk, indicating that the field starts at the first byte after the last position of the previous field.

start A positive integer that indicates the start column of the data field.

The default value is **POSITION(*)**.

The first column (byte position) of an output record corresponds to POSITION(1). If you specify HEADER NONE in the FROM TABLE clause, the item that is specified by the HEADER option is placed at the beginning of all the records that are unloaded from the table. You must account for the space for the record header:

- HEADER OBID (the default case): 2 bytes from position 1.
- HEADER CONST 'string' or X'*hex-string*' case: The length of the given string from position 1.

If the source table column can be null, the utility places a NULL indicator byte at the beginning of the data field in the output record. For BLOBF, CLOBF, or DBCLOBF columns, null values are indicated by a byte at the beginning of the file name. The *start* parameter (or *) points to the position of the NULL

indicator byte. In the generated LOAD statement, *start* is shifted by 1 byte to the right (as *start+1*) so that, in the LOAD statement, the start parameter of the POSITION option points to the next byte past the NULL indicator byte.

For a varying-length field, a length field precedes the actual data field (after the NULL indicator byte, if applicable). For BLOBF, CLOBF, or DBCLOBF columns, the length of the file name is indicated by two bytes at the beginning of the file name. If the value cannot be null, the *start* parameter (or *) points to the first byte of the length field. The size of the length field is either 4 bytes (BLOB, CLOB, or DBCLOB) or 2 bytes (VARCHAR or VARGRAPHIC).

When you explicitly specify the output field positions by using *start* parameters (or using the * format) of the POSITION option, you must consider the following items as a part of the output field:

- For a field whose value can be null, a space for the NULL indicator byte
- For varying-length data, a space for the length field (either 2 bytes or 4 bytes)

"Layout of output fields" on page 870 illustrates the field layout in conjunction with the POSITION option, NULL indicator byte, the length field for a varying-length field, the *length* parameter, and the actual data length.

The POSITION option is useful when the output fields must be placed at specific positions in the output records. The use of the POSITION parameters, however, can restrict the size of the output data fields. Use care when explicitly specifying *start* parameters for nullable and varying-length fields. The TRUNCATE option might be required, if applicable, to fit a data item in a shorter space in an output record.

If you omit the POSITION option for the first field, the field starts from position 1 if HEADER NONE is specified. Otherwise, the field starts from the next byte position past the record header field. If POSITION is omitted for a subsequent field, the field is placed next to the last position of the previous field without any gap.

If NOPAD is specified and POSITION parameters are given for certain fields, the effect of the NOPAD option might be lost because the fields with *start* parameters (other than the default *) always start at the fixed positions in the output records.

The POSITION option is ignored for delimited output files.

CHAR

Indicates that the output field is a character type with fixed length. You can use CHARACTER in place of CHAR. If the source table column can be null, a NULL indicator byte is placed at the beginning of the output field for a non-delimited output file.

If you specify the EBCDIC, ASCII, UNICODE, or CCSID options, the output data that corresponds to the specified option, is encoded in the CCSID, depending on the subtype of the source data (SBCS or MIXED). If the subtype is BIT, no conversion is applied.

(length)

Specifies the size of the output data in bytes.

If followed by BLOBF, CLOBF, or DBCLOBF, the length specifies the size of the expanded template name in bytes.

If the *length* parameter is omitted, the default is the maximum length that is defined on the source table column or the length in bytes of the

expanded template name if BLOBF, CLOBF, or DBCLOBF follows the CHAR keyword. When the *length* parameter is specified:

- If the *length* is less than the size of the table column, the data is truncated to the length if the TRUNCATE keyword is present; otherwise, a conversion error occurs.
- For the case where BLOBF, CLOBF, or DBCLOBF immediately follows, an error will occur if the *length* is less than the size of the expanded template name.
- If the *length* is larger than the size of the table column, the output field is padded by the default pad characters to the specified length.

BLOBF
Specifies that the output field is to contain the name of the file to which the BLOB or XML is to be unloaded without CCSID conversion.

BINARYXML Specifies that the XML document is to be unloaded using file reference variables in Extensible Dynamic Binary XML DB2 Client/Server Binary XML Format (binary XML) format. This option is only supported when unloading an XML column.

CLOBF
Specifies that the output field is to contain the name of the file to which the CLOB or XML is to be unloaded with any required CCSID conversion.

DBCLOBF
Specifies that the output field is to contain the name of the file to which the DBCLOBF or XML is to be unloaded with any required CCSID conversion.

TRUNCATE
Indicates that a character string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output record. Truncation occurs at the character boundary. See "Specifying TRUNCATE and STRIP options for output data" on page 875 for the truncation rules that are used in the UNLOAD utility. Without TRUNCATE, an error occurs when the output field size is too small for the data.

VARCHAR
Specifies that the output field type is character of varying length. A 2-byte binary field indicating the length of data in bytes is prepended to the data field. If the table column can be null, a NULL indicator byte is placed before this length field for a non-delimited output file.

If you specify the EBCDIC, ASCII, UNICODE, or CCSID options, the output data is encoded in the CCSID corresponding to the specified option, depending on the subtype of the source data (SBCS or MIXED). If the subtype is BIT, no conversion is applied.

(length)
Specifies the maximum length of the actual data field in bytes. If you also specify NOPAD, it indicates the maximum allowable space for the data in the output records; otherwise, the space of the specified length is reserved for the data.

If followed by BLOBF, CLOBF, or DBCLOBF, length specifies the size of the expanded template name in bytes. If the length is less than the size of the expanded template name an error will occur.

If the length parameter is omitted, the default is the smaller of 255 and the maximum length that is defined on the source table column.

BLOBF
Specifies that the output field is to contain the name of the file to which the BLOB or XML is to be unloaded without CCSID conversion.

BINARYXML Specifies that the XML document is to be unloaded using file reference variables in binary XML format. This option is only supported when unloading an XML column.

CLOBF
Specifies that the output field is to contain the name of the file to which the CLOB or XML is to be unloaded with any required CCSID conversion.

DBCLOBF
Specifies that the output field is to contain the name of the file to which the DBCLOBF or XML is to be unloaded with any required CCSID conversion.

STRIP
Specifies that UNLOAD is to remove binary zeroes (the default) or the specified string from the beginning, the end, or both ends of the data. UNLOAD adjusts the VARCHAR length field (for the output field) to the length of the stripped data.

The STRIP option is applicable if the subtype of the source data is BIT. In this case, no CCSID conversion is performed on the specified strip character (even if it is given in the form *'strip-char'*).

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data. The **default** is **BOTH**.

TRAILING
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

'strip-char'
Specifies a single-byte character that is to be stripped. Specify this character value in EBCDIC. Depending on the output encoding scheme, UNLOAD applies SBCS CCSID conversion to the *strip-char* value before it is used in the strip operation. If you want to specify a *strip-char* value in an encoding scheme other than EBCDIC, use the hexadecimal form. UNLOAD does not perform CCSID conversion if the hexadecimal form is used.

X'strip-char'
Specifies a single-byte character that is to be stripped. It can be specified in the hexadecimal form, X'*hex-string*', where *hex-string* is two hexadecimal characters that represent a single SBCS character. If the *strip-char* operand is omitted, the default is the blank character, which is coded as follows:
- X'40', for the EBCDIC-encoded output case

- X'20' for the ASCII-encoded output case
- X'20' the Unicode-encoded output case

The strip operation is applied after the character code conversion, if the output character encoding scheme is different from the one that is defined on the source data. Therefore, if a strip character is specified in the hexadecimal format, you must specify the character in the encoding scheme that is used for output.

TRUNCATE
Indicates that a character string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output records. Truncation occurs at a character boundary. See "Specifying TRUNCATE and STRIP options for output data" on page 875 for the truncation rules that are used in the UNLOAD utility. Without TRUNCATE, an error occurs when the output field size is too small for the data.

GRAPHIC
Specifies that the output field is of the fixed-length graphic type. If the table column can be null, a NULL indicator byte is placed before the actual data field for any non-delimited output file.

If the output is in EBCDIC, the shift-in and shift-out characters are not included at the beginning and at the end of the data.

(length)
Specifies the number of DBCS characters (the size of the output data in bytes is twice the given length). If the given *length* is larger than the source data length, the output field is padded with the default pad character.

TRUNCATE
Indicates that a graphic character string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output records. Truncation occurs at a character (DBCS) boundary. Without TRUNCATE, an error occurs when the output field size is too small for the data.

GRAPHIC EXTERNAL
Specifies that the data is to be written in the output records as a fixed-length field of the graphic type with the external format; that is, the shift-out (SO) character is placed at the starting position, and the shift-in (SI) character is placed at the ending position. The byte count of the output field is always an even number.

GRAPHIC EXTERNAL is supported only in the EBCDIC output mode (by default or when the EBCDIC keyword is specified).

If the *start* parameter of the POSITION option is used to specify the output column position, it points to the (inserted) shift-out character at the beginning of the field. The shift-in character is placed at the next byte position past the last double-byte character of the data.

(length)
Specifies a number of DBCS characters, excluding the shift characters (as in the graphic type column definition that is used in a CREATE TABLE statement) nor the NULL indicator byte if the source column can be null. If the length parameter is omitted, the default output field size is the length that is defined on the corresponding table column, plus two bytes (shift-out and shift-in characters).

If the specified *length* is larger than the size of the data, the field is padded on the right with the default DBCS padding character.

TRUNCATE
Indicates that a graphic character string is to be truncated from the right by the DBCS characters, if the data does not fit in the available space for the field in the output records. Without TRUNCATE, an error occurs when the output field size is too small for the data. An error can also occur with the TRUNCATE option if the available space is less than 4 bytes (4 bytes is the minimum size for a GRAPHIC EXTERNAL field; shift-out character, one DBCS, and shift-in character); or fewer than 5 bytes if the field is can be null (the 4 bytes plus the NULL indicator byte).

VARGRAPHIC
Specifies that the output field is to be of the varying-length graphic type. A 2-byte binary length field is prepended to the actual data field. If the table column can be null, a NULL indicator byte is placed before this length field for any non-delimited output file.

(length)
Specifies the maximum length of the actual data field in the number of DBCS characters. If you also specify NOPAD, it indicates the maximum allowable space for the data in the output records; otherwise, the space of the specified length is reserved for the data.

If the length parameter is omitted, the default is the smaller of 127 and the maximum defined length of the source table column.

STRIP
Indicates that UNLOAD is to remove binary zeroes (the default) or the specified string from the unloaded data. UNLOAD adjusts the VARGRAPHIC length field (for the output field) to the length of the stripped data (the number of DBCS characters).

The effect of the STRIP option is the same as the SQL STRIP scalar function.

BOTH
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the beginning and end of the data. The **default** is **BOTH**.

TRAILING
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the end of the data.

LEADING
Indicates that UNLOAD is to remove occurrences of blank or the specified strip character from the beginning of the data.

X'strip-char'
Specifies a DBCS character that is to be stripped in the hexadecimal format, **X**'*hhhh*', where *hhhh* is four hexadecimal characters that represent a DBCS character. If this operand is omitted, the default is a DBCS blank in the output encoding scheme (for example, X'4040' for the EBCDIC-encoded output or X'8140' for CCSID 301).

The strip operation is applied after the character code conversion, if the output character encoding scheme is different from the one that is defined on the source data. Therefore, if you specify a strip character, it must be in the encoding scheme that is used for the output.

TRUNCATE
Indicates that a graphic character string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output records. Truncation occurs at a DBCS character boundary. Without TRUNCATE, an error occurs when the output field size is too small for the data.

SMALLINT
Specifies that the output field is a 2-byte binary integer (a negative number is in two's complement notation). To use the external format, specify **INTEGER EXTERNAL**.

If the source data type is INTEGER, DECIMAL, FLOAT, BIGINT, or DECFLOAT (either 4-byte or 8-byte format), an error occurs when the data is greater than 32 767 or less than -32 768.

A SMALLINT output field requires 2 bytes, and the *length* option is not available.

INTEGER
Specifies that the output field is a 4-byte binary integer (a negative number is in two's complement notation).

If the original data type is DECIMAL, FLOAT, BIGINT, or DECFLOAT (either 4-byte or 8-byte format), an error occurs when the original data is greater than 2 147 483 647 or less than -2 147 483 648.

An INTEGER output field requires 4 bytes, and the *length* option is not available.

INTEGER EXTERNAL
Specifies that the output field is to contain a character string that represents an integer number.

(length)
Indicates the size of the output data in bytes, including a space for the sign character. When the *length* is given and the character notation does not fit in the space, an error occurs. The default is 20 characters (including a space for the sign).

If the value is negative, a minus sign precedes the numeric digits. If the output field size is larger than the length of the data, the output data is left justified and blanks are padded on the right.

If the source data type is DECIMAL, FLOAT (either 4-byte or 8-byte format), or DECFLOAT (either 8-byte or 16-byte format), an error occurs when the original data is greater than 9 223 372 036 854 775 807 or less than -9 223 372 036 854 775 808.

BIGINT
Specifies that the output field is an 8-byte binary integer (a negative number is in two's complement notation). To use the external format, specify **INTEGER EXTERNAL**.

If the original data type is DECIMAL, FLOAT, or DECFLOAT (either 4-byte or 8-byte format), an error occurs when the original data is greater than 9 223 372 036 854 775 807 or less than -9 223 372 036 854 775 808.

BINARY(*length*)
Indicates that the output field is a binary string type with a fixed length. If the source table column can be null, a NULL indicator byte is placed at the

beginning of the output field for a nondelimited output file. No data conversion is applied to the field. The default for *X'strip-char'* is hexadecimal zero (X'00').

TRUNCATE
Indicates that the output binary string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output records. Without TRUNCATE, an error occurs when the output field size is too small for the data.

VARBINARY
Indicates that the output field is a binary string type with varying length. A 2-byte binary field indicating the length of data in bytes is prepended to the data field. If the table column can be null, a NULL indicator byte is placed before the length field for a non-delimited output file. No data conversion is applied to the field. The default for *X'strip-char'* is hexadecimal zero (X'00').

STRIP
Specifies that UNLOAD is to remove binary zeroes (the default) or the specified string from the beginning, the end, or both ends of the data. UNLOAD adjusts the VARBINARY length field (for the output field) to the length of the stripped data.

BOTH
Indicates that UNLOAD is to remove occurrences of binary zeroes or the specified strip character from the beginning and end of the data. The **default** is **BOTH**.

TRAILING
Indicates that UNLOAD is to remove occurrences of binary zeroes or the specified strip character from the end of the data.

LEADING
Indicates that UNLOAD is to remove occurrences of binary zeroes or the specified strip character from the beginning of the data.

X'strip-char'
Specifies a single-byte character that is to be stripped. It can be specified only in the hexadecimal form, X'*hex-string*', where *hex-string* is two hexadecimal characters that represent a single SBCS character.

TRUNCATE
Indicates that a binary string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output records. Without TRUNCATE, an error occurs when the output field size is too small for the data.

DECIMAL
Specifies that the output data is a number that is represented by the indicated decimal format (either PACKED, ZONED, or EXTERNAL). If you specify the keyword DECIMAL by itself, packed-decimal format is assumed.

PACKED
Specifies that the output data is a number that is represented by the packed-decimal format. You can use **DEC** or **DEC PACKED** as an abbreviated form of the keyword.

The packed-decimal representation of a number is of the form *ddd...ds*, where *d* is a decimal digit that is represented by 4 bits, and *s* is a 4-bit sign character (hexadecimal A, C, E, or F for a positive number, and hexadecimal B or D for a negative number).

length
Specifies the number of digits (not including the sign digit) that are to be placed in the output field. The length must be between 1 and 31. If the length is odd, the size of the output data field is (*length*+1) / 2 bytes; if even, (*length* / 2)+1 byte.

If the source data type is DECIMAL and the *length* parameter is omitted, the default length is determined by the column attribute defined on the table. Otherwise, the default length is 31 digits (16 bytes).

scale
Specifies the number of digits to the right of the decimal point. (Note that, in this case, a decimal point is not included in the output field.) The number must be an integer that is greater than or equal to zero and less than or equal to the length.

The default depends on the column attribute that is defined on the table. If the source data type is DECIMAL, the defined *scale* value is the default value; otherwise, the default value is **0**.

If you specify the output field size as less than the length of the data, an error occurs. If the specified field size is greater than the length of data, X'0' is padded on the left.

ZONED
Specifies that the output data is a number that is represented by the zoned-decimal format. You can use DEC ZONED as an abbreviated form of the keyword.

The zoned-decimal representation of a number is of the form *znznzn...z/sn*, where *n* denotes a 4 bit decimal digit (called the numeric bits); *z* is the digit's zone (left 4 bits of a byte); *s* is the right-most operand that can be a zone (*z*) or can be a sign value (hexadecimal A, C, E, or F for a positive number, and hexadecimal B or D for a negative number).

length
Specifies the number of bytes (that is the number of decimal digits) that are placed in the output field. The length must be between 1 and 31.

If the source data type is DECIMAL and the *length* parameter is omitted, the default length is determined by the column attribute that is defined on the table. Otherwise, the default length is 31 bytes.

scale
Specifies the number of digits to the right of the decimal point. (Note that, in this case, a decimal point is not included in the output field.) The number must be an integer greater than or equal to zero and less than or equal to the length.

The default depends on the column attribute that is defined on the table. If the source data type is DECIMAL, the defined *scale* value is the default value; otherwise, the default value is **0**.

If you specify the output field size as less than the length of the data, an error occurs. If the specified field size is greater than the length of data, X'F0' is padded on the left.

EXTERNAL
Specifies that the output data is a character string that represents a number in the form of ±*dd...d.ddd...d*, where *d* is a numeric character 0-9. (The plus sign for a positive value is omitted.)

length
Specifies the overall length of the output data (the number of characters including a sign, and a decimal point if *scale* is specified).

If the source data type is DECIMAL and the *length* parameter is omitted, the default length is determined by the column attribute that is defined on the table. Otherwise, the default length is 33 (31 numeric digits, plus a sign and a decimal point). The minimum value of *length* is 3 to accommodate the sign, one digit, and the decimal point.

scale
Specifies the number of digits to the right of the decimal point. The number must be an integer that is greater than or equal to zero and less than or equal to *length - 2* (to allow for the sign character and the decimal point).

If the source data type is DECIMAL and the *length* parameter is omitted, the default scale is determined by the column attribute that is defined on the table. Otherwise, the default value is **0**.

An error occurs if the character representation of a value does not fit in the given or default field size (precision). If the source data type is floating point and a data item is too small for the precision that is defined by *scale*, the value of zero (not an error) is returned.

FLOAT*(length)*
Specifies that the output data is a binary floating-point number (32-bit or single-precision FLOAT if the *length* is between one and 21 inclusive; 64-bit or double-precision FLOAT if the *length* is between 22 and 53 inclusive). If the *length* parameter is omitted, the 64-bit format is assumed (output field size is 8 bytes). Note that the *length* parameter for the FLOAT type does not represent the field size in bytes.

The format of the binary floating-point output is controlled by the global FLOAT option. The default is S/390 format (Hexadecimal Floating Point or HFP). If you specify FLOAT(IEEE), all the binary floating-point output is in IEEE format (Binary Floating Point or BFP). When you specify FLOAT(IEEE) and the source data type DOUBLE is unloaded as REAL, an error occurs if the source data cannot be expressed by the IEEE (BFP) 32-bit notation.

EXTERNAL*(length)*
Specifies that the output data is a number that is represented by a character string in floating-point notation, ±*d.ddd...dddE±nn*, where *d* is a numeric character (0-9) for the significant digits; *nn* after the character *E*, and the sign consists of two numeric characters for the exponent.

(length)
Specifies the total field length in bytes, including the first sign character, the decimal point, the *E* character, the second sign character, and the two-digit exponent. If the number of characters in the result is less than the specified or the default length, the result is padded to the right with blanks. The length, if specified, must be greater than or equal to 8.

The default output field size is 14 if the source data type is the 32-bit FLOAT; otherwise, the default is 24.

A FLOAT EXTERNAL output field requires a space of at least seven characters in the output record to accommodate the minimal floating point notation. Otherwise, an error occurs.

DOUBLE
Specifies that the output data is in 64-bit floating point notation. If DOUBLE is used, the *length* parameter must not be specified.

REAL
Specifies that the output data is in 32-bit floating point notation. If REAL is used, the *length* parameter must not be specified.

DATE EXTERNAL
Specifies that the output field is for a character string representation of a date. The output format of date depends on the DB2 installation.

(length)
Specifies the size of the data field in bytes in the output record. A DATE EXTERNAL field requires a space of at least 10 characters. If the space is not available, an error occurs. If the specified *length* is larger than the size of the data, blanks are padded on the right.

TIME EXTERNAL
Specifies that the output field is for a character string representation of a time. The output format of time depends on the DB2 installation.

(length)
Specifies the size of the data field in bytes in the output record. A TIME EXTERNAL field requires a space of at least eight characters. If the space is not available, a conversion error occurs. If the specified *length* is larger than the size of the data, blanks are padded on the right.

TIMESTAMP EXTERNAL
Specifies that the output field is for a character string representation of a timestamp.

(length)
Specifies the size of the data field in bytes in the output record. A TIMESTAMP EXTERNAL field requires a space of at least 19 characters. If the space is not available, an error occurs. The *length* parameter, if specified, determines the output format of the TIMESTAMP. If the specified *length* is larger than the size of the data, the field is padded on the right with the default padding character.

TIMESTAMP WITH TIMEZONE EXTERNAL
Specifies that the output field is for a character string representation of a timestamp.

(length)
Specifies the size of the data field in bytes in the output record. A TIMESTAMP WITH TIME ZONE EXTERNAL field requires a space of at least 26 characters. If the space is not available, an error occurs. The length parameter, if specified, determines the output format of the TIMESTAMP WITH TIME ZONE. If the specified length is larger than the size of the data, the field is padded on the right with the default padding character.

CONSTANT
Specifies that the output records are to have an extra field containing a constant value. The field name that is associated with the CONSTANT keyword must not coincide with a table column name (the field name is for

clarification purposes only). A CONSTANT field always has a fixed length that is equal to the length of the given string.

'string'
Specifies the character string that is to be inserted in the output records at the specified or default position. A string is the required operand of the CONSTANT option. If the given string is in the form *'string'*, it is assumed to be an EBCDIC SBCS string. However, the output string for a CONSTANT field is in the specified or default encoding scheme. (That is, if the encoding scheme used for output is not EBCDIC, the SBCS CCSID conversion is applied to the given string before it is placed in output records.)

X'hex-string'
Specifies the character string in hexadecimal form, X'*hex-string*', that is to be inserted in the output records at the specified or default position. If you want to specify a CONSTANT string value in an encoding scheme other than SBCS EBCDIC, use the hexadecimal form. No CCSID conversion is performed if the hexadecimal form is used.

For a CONSTANT field, no other field selection list options should be specified.

If a CONSTANT field is inserted, it will not be included in the generated LOAD statement (the LOAD statement is generated so that the CONSTANT field is skipped).

If you specify both FORMAT DELIMITED and CONSTANT, the generated LOAD statement is not usable.

ROWID
Specifies that the output data is of type ROWID. The field type ROWID can be specified if and only if the column that is to be unloaded is of type ROWID. The keyword is provided for consistency purposes.

ROWID fields have varying length and a 2-byte binary length field is prepended to the actual data field.

For the ROWID type, no data conversion nor truncation is applied. If the output field size is too small to unload ROWID data, an error occurs.

If the source is an image copy and a ROWID column is selected, and if the page set header page is missing in the specified data set, the UNLOAD utility terminates with the error message DSNU1228I. This situation can occur when the source is an image copy data set of DSNUM that is greater than one for a nonpartitioned table space that is defined on multiple data sets.

BLOB
Indicates that the column is to be unloaded as a binary large object (BLOB). No data conversion is applied to the field.

When you specify the BLOB field type, a 4-byte binary length field is placed in the output record prior to the actual data field. If the source table column can be null, a NULL indicator byte is placed before the length field.

(length)
Specifies the maximum length of the actual data field in bytes. If you specify NOPAD, it indicates the maximum allowable space for the data in the output records; otherwise, the space of the specified length is reserved for the data.

The maximum allowable value is 32767.

The default is the maximum length that is defined on the source table column.

TRUNCATE
Indicates that a BLOB string is to be truncated from the right, if the data does not fit in the available space for the field in the output record. For BLOB data, truncation occurs at a byte boundary. Without TRUNCATE, an error occurs when the output field size is too small for the data.

CLOB
Indicates that the column is to be unloaded as a character large object (CLOB).

When you specify the CLOB field type, a 4-byte binary length field is placed in the output record prior to the actual data field. If the source table column can be null, a NULL indicator byte is placed before the length field.

If you specify the EBCDIC, ASCII, UNICODE, or CCSID options, the output data is encoded in the CCSID corresponding to the specified option, depending on the subtype of the source data (SBCS or MIXED). No conversion is applied if the subtype is BIT.

(length)
Specifies the maximum length of the actual data field in bytes. If you specify NOPAD, it indicates the maximum allowable space for the data in the output records; otherwise, the space of the specified length is reserved for the data.

The maximum allowable value is 32767.

The default is the maximum length that is defined on the source table column.

TRUNCATE
Indicates that a CLOB string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output record. For CLOB data, truncation occurs at a character boundary. See "Specifying TRUNCATE and STRIP options for output data" on page 875 for the truncation rules that are used in the UNLOAD utility. Without TRUNCATE, an error occurs when the output field size is too small for the data.

DBCLOB
Indicates that the column is to be unloaded as a double-byte character large object (DBCLOB).

If you specify the DBCLOB field type, a 4-byte binary length field is placed in the output record prior to the actual data field. If the source table column can be null, a NULL indicator byte is placed before the length field.

If you specify the EBCDIC, ASCII, UNICODE, or CCSID options, the output data is encoded in the CCSID corresponding to the specified option; DBCS CCSID is used.

(length)
Specifies the maximum length of the actual data field in the number of DBCS characters. If you specify NOPAD, it indicates the maximum allowable space for the data in the output records; otherwise, the space of the specified length is reserved for the data.

The maximum allowable value is 32767.

The default is the maximum length that is defined on the source table column.

TRUNCATE
Indicates that a DBCS string (encoded for output) is to be truncated from the right, if the data does not fit in the available space for the field in the output record. For a DBCLOB data, truncation occurs at a character (DBCS) boundary. See "Specifying TRUNCATE and STRIP options for output data" on page 875 for the truncation rules that are used in the UNLOAD utility. Without TRUNCATE, an error occurs when the output field size is too small for the data.

DECFLOAT *(length)*
Specifies either a 128-bit decimal floating-point number or a 64-bit decimal floating-point number. The value of the length must be either 16 or 34. If the length is 16, the number is in 64 bit decimal floating-point number format. If the length is 34, the number is in 128 bit decimal floating-point format. The default length is determined by the column attribute defined on the table. Otherwise, the default length is 34 (16 bytes).

DECFLOAT EXTERNAL
Specifies a string of characters that represent a number. The format is an SQL numeric constant.

(length)
Specifies the total field length in bytes. This length includes the first sign character, the decimal point, the E character, the second sign character, and the exponent if in the string. If the number of characters in the result is less than the specified or the default length, the result is padded to the right with blanks. The character representation of a value must fit in the given or default field size.

The default output field size is 23 if the source data type is the DECFLOAT(16). Otherwise, the default is 42.

XML
Specifies that an XML column is being unloaded directly to the output record.

BINARYXML Specifies that the XML document is to be unloaded in binary XML format.

WHEN
Indicates which records in the table space are to be unloaded. If no WHEN clause is specified for a table in the table space, all of the records are unloaded.

The option following WHEN describes the conditions for unloading records from a table.

Data in the table can be in EBCDIC, ASCII, or Unicode. If the target table is in Unicode and the character constants are specified in the utility control statement as EBCDIC, the UNLOAD utility converts these constants to Unicode. To use a constant when the target table is ASCII, specify the hexadecimal form of the constant (instead of the character string form) in the condition for the WHEN clause.

selection condition
Specifies a condition that is true, false, or unknown about a given row. When the condition is true, the row qualifies for UNLOAD. When the condition is false or unknown, the row does not qualify.

The result of a selection condition is derived by application of the specified *logical operators* (AND and OR) to the result of each specified predicate. If logical operators are not specified, the result of the selection condition is the result of the specified predicate.

Selection conditions within parentheses are evaluated first. If the order of evaluation is not specified by parentheses, AND is applied before OR.

If the control statement is in the same encoding scheme as the input data, you can code character constants in the control statement. Otherwise, if the control statement is not in the same encoding scheme as the input data, you must code the condition with hexadecimal constants. For example, if the table space is in EBCDIC and the control statement is in UTF-8, use (1:1) = X'31' in the condition rather than (1:1) = '1'.

Restriction: UNLOAD cannot filter rows that contain encrypted data.

predicate
Specifies a condition that is true, false, or unknown about a row.

In the predicate, you cannot specify a DECFLOAT constant or a column of any of the following types:

DECFLOAT
LONG VARCHAR
LONG VARGRAPHIC
ROWID
CLOB
BLOB
DBCLOB

You can specify an XML column only with IS NULL or IS NOT NULL.

You can specify a VARCHAR column only with the following predicates:

- IS NULL
- IS NOT NULL
- A comparison with a HEX or fixed-length CHAR value

You can specify a VARGRAPHIC column only with the following predicates:

- IS NULL
- IS NOT NULL
- A comparison with a HEX or fixed-length GRAPHIC value

Column names in the predicate are case-sensitive. For example, if a column in the source table is named SALARY, SALARY=20000 is a valid predicate, but salary=20000 is not a valid predicate.

basic predicate
Specifies the comparison of a column with a constant. If the value of the column is null, the result of the predicate is unknown. Otherwise, the result of the predicate is true or false.

column = constant
The column is equal to the constant or labeled duration expression.

column < > constant
The column is not equal to the constant or labeled duration expression.

column > constant
The column is greater than the constant or labeled duration expression.

column < constant
The column is less than the constant or labeled duration expression.

column > = constant
The column is greater than or equal to the constant or labeled duration expression.

column < = constant
The column is less than or equal to the constant or labeled duration expression.

Note: The following alternative comparison operators are available:
!= or **¬=** for not equal.
!> or **¬>** for not greater than.
!< or **¬<** for not less than.

The symbol **¬** representing "not" is supported for compatibility purposes. Use **!** where possible.

BETWEEN predicate
Indicates whether a given value is between two other given values that are specified in ascending order. The values can be constants or labeled duration expressions. Each of the predicate's two forms (BETWEEN and NOT BETWEEN) has an equivalent search condition, as shown in the following table. When relevant, the table also shows any equivalent predicates.

Table 122. BETWEEN predicates and their equivalent search conditions

Predicate	Equivalent predicate	Equivalent search condition
column BETWEEN *value1* AND *value2*	None	(*column* >= *value1* AND *column* <= *value2*)
column NOT BETWEEN *value1* AND *value2*	NOT(*column* BETWEEN *value1* AND *value2*)	(*column* < *value1* OR *column* > *value2*)

Note: The values can be constants or labeled duration expressions.

For example, the following predicate is true for any row when salary is greater than or equal 10000 and less than or equal to 20000:

```
SALARY BETWEEN 10000 AND 20000
```

IN predicate
Specifies that a value is to be compared with a set of values. In the IN predicate, the second operand is a set of one or more values that are specified by constants. Each of the predicate's two forms (IN and NOT IN) has an equivalent search condition, as shown in the following table.

Table 123. IN predicates and their equivalent search conditions

Predicate	Equivalent search condition
value1 IN (*value1*, *value2*,..., *valuen*)	(*value1* = *value2* OR ... OR *value1* = *valuen*)
value1 NOT IN (*value1*, *value2*,..., *valuen*)	*value1* ¬= *value2* AND ... AND *value1* ¬= *valuen*)

Note: The values can be constants.

For example, the following predicate is true for any row whose employee is in department D11, B01, or C01:

```
WORKDEPT IN ('D11', 'B01', 'C01')
```

LIKE predicate

Specifies the qualification of strings that have a certain pattern.

Within the pattern, a percent sign or underscore can have a special meaning, or it can represent the literal occurrence of a percent sign or underscore. To have its literal meaning, it must be preceded by an *escape character*. If it is not preceded by an escape character, it has its special meaning. The underscore character (_) represents a single, arbitrary character. The percent sign (%) represents a string of zero or more arbitrary characters.

The ESCAPE clause designates a single character. That character, and only that character, can be used multiple times within the pattern as an escape character. When the ESCAPE clause is omitted, no character serves as an escape character, so that percent signs and underscores in the pattern always have their special meanings.

The following rules apply to the use of the ESCAPE clause:

- The ESCAPE clause cannot be used if *x* is mixed data.
- If *x* is a character string, the data type of the string constant must be character string. If *x* is a graphic string, the data type of the string constant must be graphic string. In both cases, the length of the string constant must be 1.
- The pattern must not contain the escape character except when followed by the escape character, '%' or '_'. For example, if '+' is the escape character, any occurrence of '+' other than '++', '+_', or '+%' in the pattern is an error.

When the pattern does not include escape characters, a simple description of its meaning is:

- The underscore sign (_) represents a single arbitrary character.
- The percent sign (%) represents a string of zero or more arbitrary characters.
- Any other character represents a single occurrence of itself.

Let *x* denote the column that is to be tested and *y* the pattern in the string constant. The following rules apply to predicates of the form "x LIKE y...". If NOT is specified, the result is reversed.

- When *x* and *y* are both neither empty nor null, the result of the predicate is true if *x* matches the pattern in *y* and false if *x* does not match the pattern in *y*.
- When *x* or *y* is null, the result of the predicate is unknown.
- When *y* is empty and *x* is not empty, the result of the predicate is false.
- When *x* is empty and *y* is not empty, the result of the predicate is false unless *y* consists only of one or more percent signs.
- When *x* and *y* are both empty, the result of the predicate is true.

The pattern string and the string that is to be tested must be of the same type. That is, both *x* and *y* must be character strings, or both *x* and *y* must be graphic strings. When *x* and *y* are graphic strings, a character is a DBCS character. When *x* and *y* are character strings and *x* is not mixed data, a character is an SBCS character and *y* is interpreted as SBCS data regardless of its subtype.

Strings and patterns

The string *y* is interpreted as a sequence of the minimum number of substring specifiers such that each character of *y* is part of exactly one substring specifier. A substring specifier is an underscore, a percent sign, or any non-empty sequence of characters other than an underscore or percent sign.

The string *x* matches the pattern *y* if a partitioning of *x* into substrings exists, such that:

- A substring of *x* is a sequence of zero or more contiguous characters, and each character of *x* is part of exactly one substring.
- If the *n*th substring specifier is an underscore, the *n*th substring of *x* is any single character.
- If the *n*th substring specifier is a percent sign, the *n*th substring of *x* is any sequence of zero or more characters.
- If the *n*th substring specifier is neither an underscore nor a percent sign, the *n*th substring of *x* is equal to that substring specifier and has the same length as that substring specifier.
- The number of substrings of *x* is the same as the number of substring specifiers.

When escape characters are present in the pattern string, an underscore, percent sign, or escape character represents a single occurrence of itself if and only if it is preceded by an odd number of successive escape characters.

The way a pattern is matched to evaluate the LIKE predicate depends on whether blanks at the end of fixed length strings are significant, or if the blanks are ignored. When the LIKE_BLANK_INSIGNIFICANT subsystem parameter is enabled, the LIKE predicate can produce different results.

Mixed data patterns: If *x* is mixed data, the pattern is assumed to be mixed data, and its special characters are interpreted as follows:

- A single-byte underscore refers to one single-byte character; a double-byte underscore refers to one double-byte character.
- A percent sign, either single-byte or double-byte, refers to any number of characters of any type, either single-byte or double-byte.
- Redundant shift bytes in *x* or *y* are ignored.

Related information:

LIKE predicate (DB2 SQL)

NULL predicate

Specifies a test for null values.

If the value of the column is null, the result is true. If the value is not null, the result is false. If NOT is specified, the result is reversed. (That is, if the value is null, the result is false, and if the value is not null, the result is true.)

labeled duration expression

Specifies an expression that begins with special register CURRENT DATE or special register CURRENT TIMESTAMP (the forms CURRENT_DATE and CURRENT_TIMESTAMP are also acceptable). For CURRENT TIMESTAMP, if the comparison is with a timestamp column, the timestamp precision of the special register will be the same as the column timestamp precision. Otherwise default timestamp precision will be used. This special register can be followed by arithmetic operations of addition

or subtraction. These operations are expressed by using numbers that are followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS. (The singular form of these keywords is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, and MICROSECOND.)

Utilities always evaluate a *labeled duration expression* as a timestamp and implicitly convert to a date if the comparison is with a date column.

Incrementing and decrementing CURRENT DATE: The result of adding a duration to a date, or of subtracting a duration from a date, is itself a date. (For the purposes of this operation, a month denotes the equivalent of a calendar page. Adding months to a date, then, is like turning the pages of a calendar, starting with the page on which the date appears.) The result must fall between the dates January 1, 0001 and December 31, 9999 inclusive. If a duration of years is added or subtracted, only the year portion of the date is affected. The month is unchanged, as is the day, unless the result would be February 29 of a non-leap-year. In this situation, the day portion of the result is set to 28.

Similarly, if a duration of months is added or subtracted, only months and, if necessary, years are affected. The day portion of the date is unchanged unless the result would be invalid (September 31, for example). In this case the day is set to the last day of the month.

Adding or subtracting a duration of days affects the day portion of the date, and potentially the month and year.

Date durations, whether positive or negative, can also be added to and subtracted from dates. As with labeled durations, the result is a valid date.

When a positive date duration is added to a date, or a negative date duration is subtracted from a date, the date is incremented by the specified number of years, months, and days.

When a positive date duration is subtracted from a date, or a negative date duration is added to a date, the date is decremented by the specified number of days, months, and years.

Adding a month to a date gives the same day one month later, unless that day does not exist in the later month. In that case, the day in the result is set to the last day of the later month. For example, January 28 plus one month gives February 28; one month added to January 29, 30, or 31 results in either February 28 or, for a leap year, February 29. If one or more months is added to a given date and then the same number of months is subtracted from the result, the final date is not necessarily the same as the original date.

The order in which labeled date durations are added to and subtracted from dates can affect the results. When you add labeled date durations to a date, specify them in the order of YEARS + MONTHS + DAYS. When you subtract labeled date durations from a date, specify them in the order of DAYS - MONTHS - YEARS. For example, to add one year and one day to a date, specify the following code:

When the labeled duration expression begins with special register CURRENT TIMESTAMP, the CURRENT TIMESTAMP is compared with the time zone column. The timestamp precision of the special register will be the same as the column timestamp precision. Otherwise the default timestamp precision will be used. The time zone of CURRENT

TIMESTAMP is the value of special register CURRENT TIMEZONE. The comparison is done by comparing the UTC portion.

```
CURRENT DATE + 1 YEAR + 1 DAY
```

To subtract one year, one month, and one day from a date, specify the following code:

```
CURRENT DATE - 1 DAY - 1 MONTH - 1 YEAR
```

Incrementing and decrementing timestamps: The result of adding a duration to a timestamp, or of subtracting a duration from a timestamp, is itself a timestamp. Date and time arithmetic is performed as previously defined, except that an overflow or underflow of hours is carried into the date part of the result, which must be within the range of valid dates.

Related reference:

EDITPROCs and VALIDPROCs for handling basic and reordered row formats (DB2 Administration Guide)

CREATE TABLE (DB2 SQL)

Related information:

Converting basic row format table spaces with edit and validation routines to reordered row format (DB2 Administration Guide)

Before running UNLOAD

Certain activities might be required before you run the UNLOAD utility, depending on your situation.

If you plan to run UNLOAD on encrypted data, do not use the WHEN statement to filter encrypted fields; UNLOAD cannot filter rows that contain encrypted data

Loading data into a table with an index that has a VARBINARY column

If the table into which you are loading data has an index with these characteristics, LOAD fails:

- The index was created on a VARBINARY column or a column with a distinct type that is based on a VARBINARY data type.
- The index column has the DESC attribute.

To fix the problem, drop the index, or alter the column data type to BINARY, and then rebuild the index.

Data sets that UNLOAD uses

The UNLOAD utility uses a number of data sets during its operation.

The following table lists the data sets that UNLOAD uses. The table lists the DD name that is used to identify the data set, a description of the data set, and an indication of whether it is required. Include statements in your JCL for each required data set and any optional data sets that you want to use.

Table 124. Data sets that UNLOAD uses

Data set	Description	Required?
SYSIN	Input data set that contains the utility control statement.	Yes
SYSPRINT	Output data set for messages.	Yes
SYSPUNCH	One or more work data sets that contain the generated LOAD statements for subsequently reloading the data. The default DD name is PUNCHDDN.	No[1]
Unload data set	One or more work data sets that contain the unloaded table rows. The default DD name is SYSREC.	Yes

Note:
1. Required if you request that UNLOAD generate LOAD statements by specifying PUNCHDDN in the utility control statement.

The following object is named in the utility control statement and does not require a DD statement in the JCL:

Table space
Table space that is to be unloaded. (If you want to unload only one partition of a table space, you must specify the PART option in the control statement.)

Related concepts:

"Data sets that online utilities use" on page 18

Concurrency and compatibility for UNLOAD

The UNLOAD utility has certain concurrency and compatibility characteristics associated with it.

DB2 treats Individual data partitions as distinct source objects. Utilities that operate on different partitions of the same table space are compatible.

Claims and drains:

The following table shows which claim classes UNLOAD drains and the restrictive states that the utility sets.

Table 125. Claim classes of UNLOAD operations

Target	UNLOAD	UNLOAD PART
Table space or physical partition of a table space with SHRLEVEL REFERENCE	DW/UTRO	DW/UTRO
Table space or physical partition of a table space with SHRLEVEL CHANGE	CR/UTRW	CR/UTRW
Image copy*	CR/UTRW	CR/UTRW

Table 125. Claim classes of UNLOAD operations (continued)

Target	UNLOAD	UNLOAD PART

Legend:
- DW: Drain the write claim class, concurrent access for SQL readers
- UTRO: Utility restrictive state, read-only access allowed
- CR: Claim read, concurrent access for SQL writers and readers
- UTRW: Utility restrictive state; read-write access allowed

Note: * If the target object is an image copy, the UNLOAD utility applies CR/UTRW to the corresponding table space or physical partitions to prevent the table space from being dropped while data is being unloaded from the image copy, even though the UNLOAD utility does not access the data in the table space.

Compatibility

The compatibility of the UNLOAD utility and the other utilities on the same target objects are shown in the following table. If the SHRLEVEL REFERENCE option is specified, only SQL read operations are allowed on the same target objects; otherwise SQL INSERT, DELETE, and UPDATE are also allowed. If the target object is an image copy, INSERT, DELETE, and UPDATE are always allowed on the corresponding table space. In any case, DROP or ALTER cannot be applied to the target object while the UNLOAD utility is running.

Table 126. Compatibility of UNLOAD with other utilities

Action	UNLOAD SHRLEVEL REFERENCE	UNLOAD SHRLEVEL CHANGE	FROM IMAGE COPY
CHECK DATA DELETE NO	Yes	Yes	Yes
CHECK DATA DELETE YES	No	No	No
CHECK INDEX	Yes	Yes	Yes
CHECK LOB	Yes	Yes	Yes
COPY INDEXSPACE	Yes	Yes	Yes
COPY TABLESPACE	Yes	Yes	Yes*
DIAGNOSE	Yes	Yes	Yes
LOAD SHRLEVEL CHANGE	No	Yes	Yes
LOAD SHRLEVEL NONE	No	No	No
MERGECOPY	Yes	Yes	No
MODIFY RECOVERY	Yes	Yes	No
MODIFY STATISTICS	Yes	Yes	Yes
QUIESCE	Yes	Yes	Yes
REBUILD INDEX	Yes	Yes	Yes
RECOVER (no options)	No	No	No
RECOVER ERROR RANGE	No	No	No

Table 126. Compatibility of UNLOAD with other utilities (continued)

Action	UNLOAD SHRLEVEL REFERENCE	UNLOAD SHRLEVEL CHANGE	FROM IMAGE COPY
RECOVER TOCOPY or TORBA	No	No	No
REORG INDEX	Yes	Yes	Yes
REORG TABLESPACE UNLOAD CONTINUE or PAUSE	No	No	No
REORG TABLESPACE UNLOAD ONLY or EXTERNAL	Yes	Yes	Yes
REPAIR DUMP or VERIFY	Yes	Yes	Yes
REPAIR LOCATE INDEX PAGE REPLACE	Yes	Yes	Yes
REPAIR LOCATE KEY or RID DELETE or REPLACE	No	No	No
REPAIR LOCATE TABLESPACE PAGE REPLACE	No	No	No
REPORT	Yes	Yes	Yes
RUNSTATS INDEX	Yes	Yes	Yes
RUNSTATS TABLESPACE	Yes	Yes	Yes
STOSPACE	Yes	Yes	Yes

Note: If the same data set is used as the output from the COPY utility and as the input data set of the UNLOAD utility, unexpected results can occur.

Unloading partitions

You can unload partitions in one of two ways.

About this task

Regardless of the method, the unloaded data can be stored in a single data set for all selected partitions or in one data set for each selected partition. If you want to unload to a single output data set, specify a DD name to UNLDDN. If you want to unload into multiple output data sets, specify a template name that is associated with the partitions. You can process multiple partitions in parallel if the TEMPLATE definition contains the partition as a variable, for example &PA.

You cannot specify multiple output data sets with the FROMCOPY or the FROMCOPYDDN option.

Procedure

If the source table space is partitioned, use only one of the following methods to select the partitions to unload:

- Use the LIST keyword with a LISTDEF that contains PARTLEVEL specifications. Partitions can be either included or excluded by the use of the INCLUDE and the EXCLUDE features of LISTDEF.
- Specify the PART keyword to select a single partition or a range of partitions.

Unloading XML data

You can unload XML data in one of two ways.

About this task

XML columns can be unloaded with either of the following methods:

- The XML column can be unloaded to the output records. XML column value can be placed in the OUTPUT record with or without any other unloading column values. The output record can be in delimited or non-delimited format. For a non-delimited format, the XML column is handled like a variable character with a 2-byte length preceding the XML value. For a delimited format there are no length bytes present. If the total output record length is more than 32 KB, unload the record in spanned record format by specifying the SPANNED YES option.
- The XML column can be unloaded to a separate file whether the XML column length is less than 32K or not.

To unload XML data directly to output record:

Specify XML as the output field type. If the output is a non-delimited format, a 2-byte length will precede the value of the XML. For delimited output, no length field is present. XML is the only acceptable field type when unloading the XML directly to the output record. No data type conversion applies and you cannot specify FROMCOPY.

If the input data is in Extensible Dynamic Binary XML DB2 Client/Server Binary XML Format (binary XML format), you need to specify BLOBF BINARYXML.

To unload XML data to a separate file:

- In the UNLOAD utility control statement, specify BLOBF, CLOBF or DBCLOBF. These keywords indicate that the output column contains the name of a file to which the XML value is to be unloaded. Also specify either CHAR or VARCHAR instead of XML. Do not specify FROMCOPY.

  Example: The following UNLOAD statement specifies that the data from the XML column ORDER_CREATE_XML1 is to be unloaded to the file that is defined by template BLOBFC1.

  ```
  UNLOAD DATA FROM TABLE SCQA0000.TB_ORDER_PBR
     (ORDER_CREATE_XML1  POSITION(*) VARCHAR BLOBF BLOBFC1
     ,ORDER_ALL_LOCAL POSITION(*) INTEGER
     )
  ```

- Use the template control statement to create the XML output file and filename. If data sets are not created and the DSN type is not specified on the template, UNLOAD will use PDS as the data set type. PDS has a limit of single volume.

The output file uses multiple volumes, so you must specify HFS as the DSN type. See “Data sets that UNLOAD uses” on page 857.

Unloading LOB data

You can unload LOB data in one of two ways.

About this task

LOB columns can be unloaded with either of the following methods:

- The LOB column can be unloaded to the output records. The LOB column value can be placed in the OUTPUT record with or without any other unloading column values. The output record can be in delimited or non-delimited format. For a non-delimited format, the LOB column is handled like a variable character with a 2-byte length preceding the LOB value. For a delimited format there are no length bytes present. If the total output record length is more than 32 KB, unload the record in spanned record format by specifying the SPANNED YES option.
- The LOB column can be unloaded to a separate file whether the LOB column length is less than 32K or not.

Procedure

To unload LOB data, use one of the following methods:

- To unload LOB data directly to output record:

  Specify LOB as the output field type. If the output is a non-delimited format, a 2-byte length will precede the value of the LOB. For delimited output, no length field is present. LOB is the only acceptable field type when unloading the LOB data directly to the output record. No data type conversion applies and you cannot specify FROMCOPY.
- To unload LOB data to a separate file:
  - Create an UNLOAD utility control statement. Specify BLOBF, CLOBF or DBCLOBF to indicate that the output column contains a filename which the LOB value is to be unloaded. You cannot specify FROMCOPY.
  - Use the template control statement to create the LOB output file and filename. If data sets are not created and the DSN type is not specified on the template, UNLOAD will use PDS as the data set type. PDS has a limit of single volume. The output file uses multiple volumes, so you must specify HFS as the DSN type. See “Data sets that UNLOAD uses” on page 857.

  If you unload data to a separate file, and the LOB column from which you unload is empty, the data set that is specified by UNLDDN contains one of the following items:
  - A blank file name if the source column is specified as CHAR CLOBF, CHAR BLOBF, or CHAR DBCLOBF
  - A file name with length 0 if the source column is specified as VARCHAR CLOBF, VARCHAR BLOBF, or VARCHAR DBCLOBF

  The UNLOAD utility does not create a data set or file for the empty LOB.

Unloading data in spanned record format

If you want to unload data from a table that has large LOB or XML fields, consider unloading the data in spanned record format to improve the performance of read/write operations.

About this task

When you unload data in spanned record format, all LOB and XML data for a table space or table space partition can be written to an individual sequential file. This file can reside on DASD and can span multiple volumes. Having such a single sequential file can improve the performance of read/write operations.

UNLOAD SPANNED YES ignores large block interface (LBI) if used by any output data sets.

Procedure

To unload data in spanned record format:

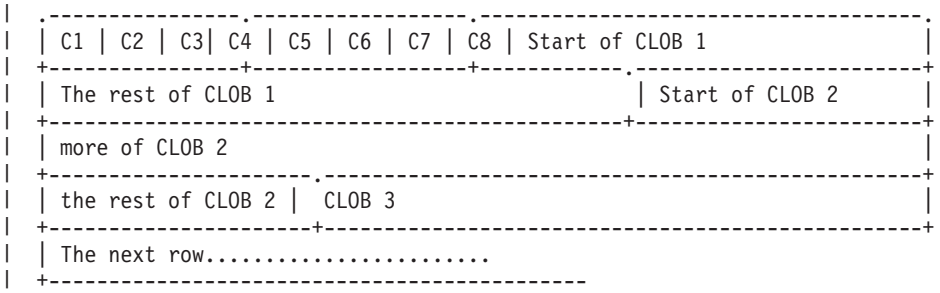
Specify the SPANNED YES option. Specify in the field specification list that all LOB and XML data are to be at the end of the record.

Example: The following UNLOAD statement specifies that the data from table TB1 is to be unloaded in spanned record format. Notice that in the field specification list, the CLOB columns are listed at the end and POSITION is not specified.

```
UNLOAD TABLESPACE TESTDB1.CLOBBASE SPANNED YES
      FROM TABLE TB1
        (ID
        ,C1 INTEGER
        ,C2 INTEGER
        ,C3 CHAR(100)
        ,C4 CHAR(100)
        ,C5 INTEGER
        ,C6 CHAR(100)
        ,C7 CHAR(100)
        ,C8 CHAR(100)
        ,CLOB1 CLOB
        ,CLOB2 CLOB
        ,CLOB3 CLOB)
```

Results

Example of spanned record format: The following figure shows a conceptual example of a spanned record that was unloaded.



What to do next

When you run LOAD on data that was unloaded in spanned record format, use the LOAD statements that are in the SYSPUNCH data sets after UNLOAD runs. Those LOAD statements include SORTKEYS parameters with accurate values. During LOAD, DB2 cannot estimate the size of the sort work data sets by checking the contents of the SYSREC data sets that are produced during UNLOAD with SPANNED YES.

Related concepts:

Large Block Interface (LBI) (z/OS DFSMS Using Data Sets)

Selecting tables and rows to unload

If a table space contains multiple tables, you can select specific tables to unload.

About this task

To select tables and rows to unload:

Procedure

In the UNLOAD utility control statement, use the FROM TABLE specification clause. Use one instance of the FROM TABLE clause for each table that is to be unloaded.
Within a FROM TABLE clause, you can specify one or more of the following criteria:

- Row and column selection criteria by using the field specification list
- Row selection conditions by using the WHEN specification clause
- Row sampling specifications

If you do not specify at least one FROM TABLE clause, the rows from all the tables in the table space are unloaded.
If you specify one or more FROM TABLE clauses for a table space, only the qualified rows from the specified tables are unloaded.

Related information:

"FROM-TABLE-spec syntax diagram and option descriptions" on page 831

Selecting and ordering columns to unload

Use a field specification list in a FROM TABLE clause to unload specified columns in the listed order. If you omit a field specification list, all the columns in the row are unloaded in the order of the columns that are defined on the table.

About this task

You can specify a format conversion option for each field in the field specification list.

If you select a LOB column in a list of field specifications or select a LOB column by default (by omitting a list of field specifications), LOB data is materialized in the output. However, you cannot select LOB columns from image copy data sets.

Unloading data from image copy data sets

In addition to unloading data from table spaces and partitions, you can also unload data from one or more image copy data sets. The UNLOAD utility accepts full image copies, incremental image copies, and copies of pieces as valid input sources.

Before you begin

Ensure that the image copy data set that you want to unload from meets the following requirements:

- The source image copy data set must be created by one of the following utilities:
  - COPY
  - COPYTOCOPY
  - LOAD inline image copy
  - MERGECOPY
  - REORG TABLESPACE inline image copy
  - DSN1COPY
- The image copy data set must be for a single table space.
- If you want to unload a ROWID column, the image copy must contain the page set header page.
- If you want to use UNLOAD to process image copies from different versions, the copy must be created with the SYSTEMPAGES YES option.
- If you want to unload compressed records, the image copy can be a full image copy or an incremental image copy. In either case, the copy must be created with the SYSTEMPAGES YES option. If the image copy data set is an incremental image copy or a copy of a partition or partitions, the same data set must contain the dictionary pages for decompression. If an image copy data set contains a compressed row and a dictionary is not available, DB2 issues an error message.
- The copy cannot be a VSAM FlashCopy image copy. If the object does not require system pages in front, you can create an image copy as a workaround. Use the COPY utility or COPYTOCOPY utility to create a sequential format image copy from the FlashCopy image copy. Then, use the sequential format image copy as input for UNLOAD.
- If an image copy contains data for columns that no longer exist in the catalog because the columns were dropped, UNLOAD cannot unload from this image copy. UNLOAD issues message DSNU1227I with return code 8.

About this task

Restriction: You cannot unload LOB data or XML data from copies.

Procedure

To unload data from image copy data sets:

Specify either the FROMCOPY or FROMCOPYDDN option in the UNLOAD utility control statement as follows:

FROMCOPY
Use the FROMCOPY option to unload rows from a single image copy data set.

You can use the FROMCOPY option to specify a full or incremental copy of partitions of a segmented table space that consists of multiple data sets. However, if a mass delete operation occurred for a table in the table space before you created the copy, the utility might not unload the deleted rows. The utility unloads deleted rows only if the space map pages that indicate the mass delete are not included in the data set that corresponds to the specified copy. Therefore, where possible, use the FROMCOPYDDN option to concatenate the copy of table space partitions.

FROMCOPYDDN
Use the FROMCOPYDDN option to unload data from one or more image copy data sets that are associated with the specified DD name.

You can use this option to concatenate the copy of table space partitions under a DD name to form a single input data set image. When you use the FROMCOPYDDN option, concatenate the data sets in the order of the data set number; the first data set must be concatenated first. If the data sets are concatenated in the wrong order or if different generations of image copies are concatenated, the results might be unpredictable. For example, if the most recent image copy data sets and older image copies are intermixed, the results might be unpredictable.

You can also use the FROMCOPYDDN option to concatenate a full image copy and incremental image copies for a table space, a partition, or a piece. However, duplicate rows are also unloaded. Instead, consider using the MERGECOPY utility to generate an updated full image copy as the input to UNLOAD.

When you specify the FROMCOPY or the FROMCOPYDDN option, you can specify only one output data set.
You can select specific rows and columns to unload just as you would for a table space. You can specify the selection criteria with either the PART keyword, the FROM TABLE clause, or both, to qualify tables and rows that are to be unloaded. However, do not include LOB columns in the field specification list. You can unload rows that contain LOB columns only when the LOB columns are excluded. Specify the table space name in the TABLESPACE option. The specified table space must exist when you run UNLOAD. (The table space cannot have been dropped since the image copy was taken.) If an image copy contains rows from dropped tables, UNLOAD ignores these rows.
After you run UNLOAD, the image copy data is unloaded to the output data set. However, certain situations can affect the output as follows:

- Suppose that the image copy contains a table to which ALTER ADD COLUMN was applied after the image copy was taken. In this case, UNLOAD sets the system or user-specified default value for the added column when the data is unloaded from such an image copy.
- If an image copy was created by an inline copy operation, the image copy can contain duplicate pages. If duplicate pages exist, UNLOAD issues a warning message, and all the qualified rows in duplicate pages are unloaded into the output data set.
- If the image copy was taken with the SHRLEVEL CHANGE option specified, rows might be updated or moved. As a result, data that is unloaded from such a copy might contain duplicates of these rows.

The later two situations can be prevented by using an image copy that was taken from a consistent FlashCopy.

Related reference:

"Syntax and options of the COPY control statement" on page 141

"Syntax and options of the COPYTOCOPY control statement" on page 192

"Syntax and options of the MERGECOPY control statement" on page 374

"Syntax and options of the UNLOAD control statement" on page 818

"Sample UNLOAD control statements" on page 878

Data conversion with the UNLOAD utility

You can convert one data type to another compatible data type by using the UNLOAD utility. The source type is used for user-defined distinct types.

For example, you can convert columns of a numeric type (SMALLINT, INTEGER, FLOAT, DOUBLE, REAL, and DECIMAL) from the DB2 internal format to the S/390 or an external format.

When you unload a floating-point type column, you can specify the binary form of the output to either the S/390 format (hexadecimal floating point, or HFP), or the IEEE format (binary floating point, or BFP).

You can also convert a varying-length column to a fixed-length output field, with or without padding characters. In either case, unless you explicitly specify a fixed-length data type for the field, the data itself is treated as a varying-length data, and a length field is appended to the data.

For certain data types, you can unload data into fields with a smaller length by using the TRUNCATE or STRIP options. In this situation, if a character code conversion is applied, the length of the data in bytes might change due to the code conversion. The truncation operation is applied after the code conversion.

You can perform character code conversion on a character type field, including converting numeric columns to the external format and the CLOB type. Be aware that when you apply a character code conversion for mixed-data fields, the length of the result string in bytes can be shorter or longer than the length of the source string. Character type data is always converted if you specify any of the character code conversion options (EBCDIC, ASCII, UNICODE, or CCSID).

DATE, TIME, or TIMESTAMP column types are always converted into the external formats based on the DATE, TIME, and TIMESTAMP formats of your installation.

Output field types

An output field can have a different data type from the one that is defined on a source table column if the data types are compatible. The UNLOAD utility follows the general DB2 rules and conventions for the data type attributes and the compatibility among the data types.

If you specify a data type in the UNLOAD control statement, the field type information is included in the generated LOAD utility statement. For specific data type compatibility information, refer to the following table. These tables show the compatibility of the data type of the source column (input data type) with the data type of the output field (output data type). A Y indicates that the input data type can be converted to the output data type.

The following table shows the compatibility of converting numeric data types.

Table 127. Compatibility of converting numeric data types

	Output data types						
Input data types	**SMALLINT**	**INTEGER (external)**	**BIGINT**	**DECIMAL (external)**	**FLOAT (external)**	**DOUBLE or REAL**	**FLOAT/REAL**
SMALLINT	Y	Y[1]	Y	Y[1]	Y[1]	Y	Y
INTEGER	Y[2]	Y[1]	Y	Y[1]	Y[1]	Y	Y
BIGINT	Y[2]	Y[2]	Y[2]	Y	Y	N	Y
DECIMAL	Y[2]	Y[1, 2]	Y[2]	Y[1]	Y[1]	Y	Y
FLOAT, DOUBLE, or REAL	Y[2]	Y[1, 2]	Y[2]	Y[1, 2]	Y[1]	Y	Y
DECFLOAT	Y[2]	Y[1, 2]	Y[2]	Y[1, 2]	Y[1, 2]	N[2]	Y[3]

Table 127. Compatibility of converting numeric data types (continued)

	Output data types						
Input data types	**SMALLINT**	**INTEGER (external)**	**BIGINT**	**DECIMAL (external)**	**FLOAT (external)**	**DOUBLE or REAL**	**FLOAT/REAL**

Note:

1. Subject to the CCSID conversion, if specified (EXTERNAL case).
2. Potential overflow (conversion error).
3. When converting from DECFLOAT(34) to DECFLOAT(16), you might encounter overflow, underflow, subnormal number, or inexact. However, there will be no conversion error.

The following table shows the compatibility of converting character data types.

Table 128. Compatibility of converting character data types

	Output data types									
Input data types	**BLOB**	**CHAR**	**VAR-CHAR**	**CLOB**	**GRAPHIC**	**GRAPHIC EXTER-NAL**	**VAR-GRAPHIC**	**DB-CLOB**	**BINARY**	**VAR-BINARY**
BLOB	Y	N	N	N	N	N	N	N	N	N
CLOB	N	Y[1, 2]	Y[1, 2]	Y	N	N	N	N	N	N
DBCLOB	N	N	N	N	Y[1, 2]	Y[1, 2, 3]	Y[1, 2]	Y[1]	N	N
CHAR	N	Y[1]	Y[1]	Y[1, 4]	N	N	N	N	Y	Y
VARCHAR or LONG VARCHAR	N	Y[1,2]	Y[1]	Y[1, 4]	N	N	N	N	Y	Y
GRAPHIC	N	N	N	N	Y[1]	Y[1, 3]	Y[1]	Y[1]	N	N
VAR-GRAPHIC or LONG VAR-GRAPHIC	N	N	N	N	Y[1, 2]	Y[1, 2, 3]	Y[1]	Y[1]	N	N
BINARY	Y	N	N	N	N	N	N	N	Y	Y
VARBINARY	Y	N	N	N	N	N	N	N	Y	Y

Note:

1. Subject to the CCSID conversion, if specified.
2. Results in an error if the field length is too small for the data unless you specify the TRUNCATE option. Note that a LOB has a 4-byte length field; any other varying-length type has a 2-byte length field.
3. Only in the EBCDIC output mode.
4. Not applicable to BIT subtype data.

The following table shows the compatibility of converting time data types.

Table 129. Compatibility of converting time data types

	Output data types			
Input data types	**DATE EXTERNAL**	**TIME EXTERNAL**	**TIMESTAMP EXTERNAL**	**TIMESTAMP WITH TIME ZONE EXTERNAL**
DATE	Y[1]	N	Y[1, 2]	Y[1,2]
TIME	N	Y[1]	N	N
TIMESTAMP	Y[1, 3]	Y[1, 3]	Y[1]	Y[1,2]
TIMESTAMP WITH TIME ZONE	Y[1,4]	Y[1,4]	Y[1,4]	Y[1]

Table 129. Compatibility of converting time data types (continued)

	Output data types			
Input data types	**DATE EXTERNAL**	**TIME EXTERNAL**	**TIMESTAMP EXTERNAL**	**TIMESTAMP WITH TIME ZONE EXTERNAL**

Note:

1. Subject to the CCSID conversion, if specified.
2. Zeros in the time portion. IMPLICIT_TZ in time zone portion if the output data type is TIMESTAMP WITH TIME ZONE.
3. DATE or TIME portion of the timestamp.
4. DATE, TIME or TIMESTAMP portion of the timestamp with time zone.

Related concepts:

Data types (DB2 SQL)

Related reference:

"Syntax and options of the UNLOAD control statement" on page 818

Output field positioning and size

By default, output data is always placed in an output record in the order of the defined columns over the selected tables. You can choose to specify the order of the output fields by using a list of field specifications.

Use the POSITION option to specify field position in the output records. You can also specify the size of the output data field by using the *length* parameter for a particular data type. The *length* parameter must indicate the size of the actual data field. The *start* parameter of the POSITION option indicates the starting position of a field, including the NULL indicator byte (if the field can be null) and the length field (if the field is varying length).

Using the POSITION parameter, the length parameter, or both can restrict the size of the data field in the output records. Use care when specifying the POSITION and length parameters, especially for nullable fields and varying length fields. If a conflict exists between the *length* parameter and the size of the field in the output record that is specified by the POSITION parameters, DB2 issues an error message, and the UNLOAD utility terminates. If an error occurs, the count of the number of records in error is incremented. See the description of the MAXERR option of UNLOAD for more information.

If you specify a length parameter for a varying-length field and you also specify the NOPAD option, *length* indicates the maximum length of data that is to be unloaded. Without the NOPAD option, UNLOAD reserves a space of the given *length* instead of the maximum data size.

If you explicitly specify start parameters for certain fields, they must be listed in ascending order in the field selection list. Unless you specify HEADER NONE for the table, a fixed-length record header is placed at the beginning of each record for the table, and the start parameter must not overlap the record header area.

The TRUNCATE option is available for certain output field types. For the output field types where the TRUNCATE option is not applicable, enough space must be provided in the output record for each field.

Related concepts:

"Field specification errors" on page 877
"Layout of output fields"
"Specifying TRUNCATE and STRIP options for output data" on page 875
Related reference:
"Syntax and options of the UNLOAD control statement" on page 818

Layout of output fields

The layout of output fields vary based on a variety of factors, including whether the field is varying-length or fixed-length and whether the field is nullable.

Output fields can have the following layouts:

- Fixed-length
- Nullable fixed-length
- Varying-length field
- Varying-length field without the NOPAD option
- Nullable varying-length field with the NOPAD option
- Nullable varying-length field without the NOPAD option

The following figure shows the layout of a fixed-length field that cannot be null. This diagram shows that the data field begins at a specified position, or at the next byte position past the end of the previous data field. The data field then continues for the specified length or the length of the column in the table definition. For GRAPHIC EXTERNAL data, shift-in and shift-out characters are inserted before and after the data.

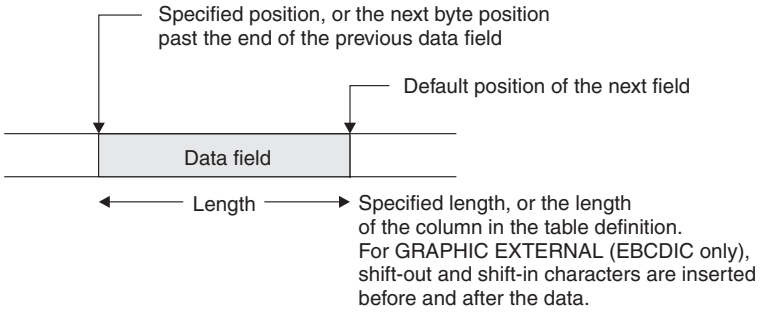


Figure 97. Layout of a fixed-length field (NOT NULL)

The following figure shows the layout of a fixed-length field that can be null. This diagram shows that a null indicator byte is stored before the data field, which begins at the specified position or at the next byte position past the end of the previous data field.

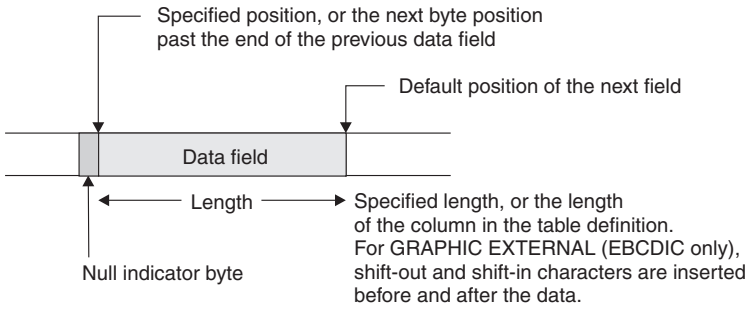


Figure 98. Layout of a nullable fixed-length field

If you are running UNLOAD with the NOPAD option and need to determine the layout of a varying-length field that cannot be null, see the layout diagram in the following figure. The length field begins at the specified position or at the next byte position past the end of the previous data field.

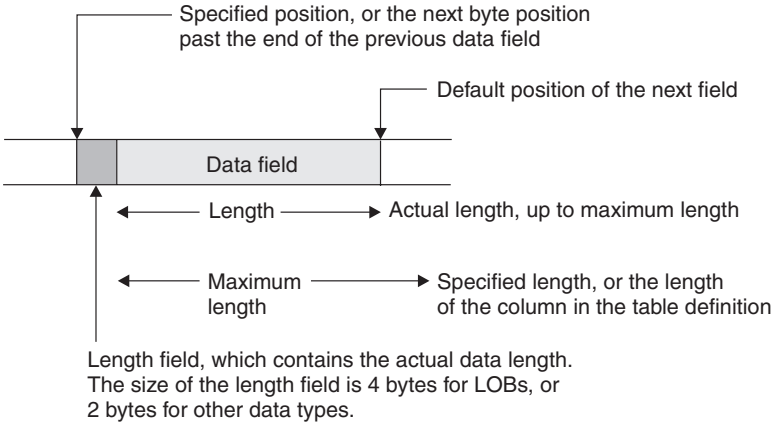


Figure 99. Layout of a varying-length field (NOT NULL) with the NOPAD option

For UNLOAD without the NOPAD option, the layout of a varying-length field that cannot be null is depicted in the following figure.

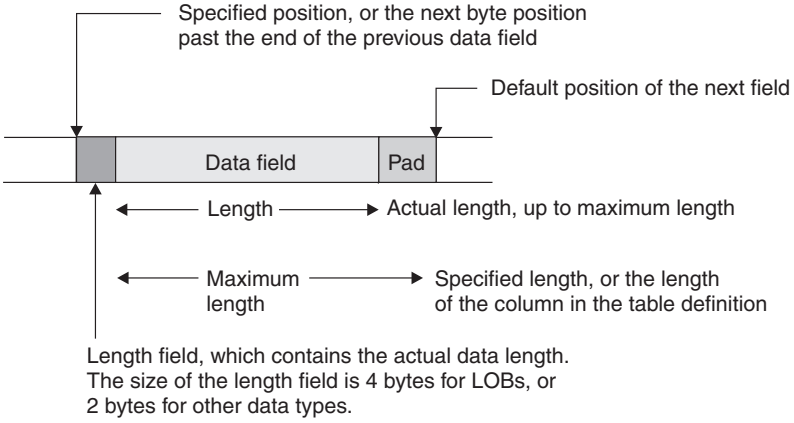


Figure 100. Layout of a varying-length field (NOT NULL) without the NOPAD option

For UNLOAD with the NOPAD option, the layout of a varying-length field that can be null is depicted in the following figure. The length field begins at the

specified position or at the next byte position past the end of the previous data field.

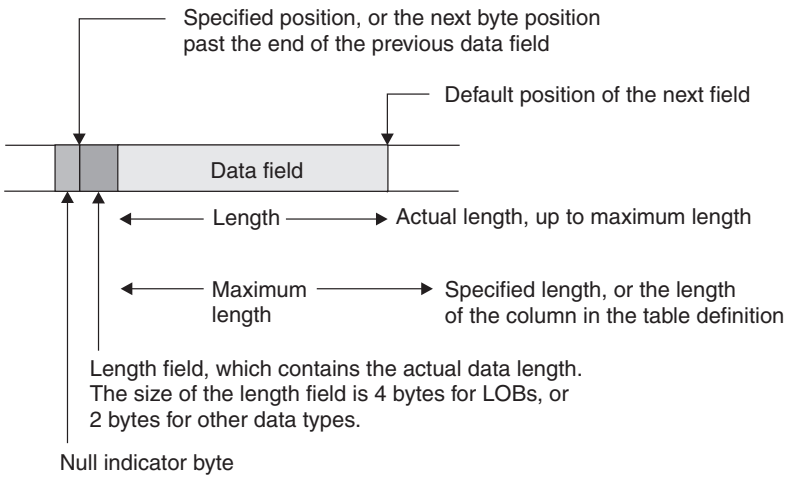


Figure 101. Layout of a nullable varying-length field with the NOPAD option

For UNLOAD without the NOPAD option, the layout of a varying-length field that can be null is depicted in the following figure. The length field begins at the specified position or at the next byte position past the end of the previous data field.

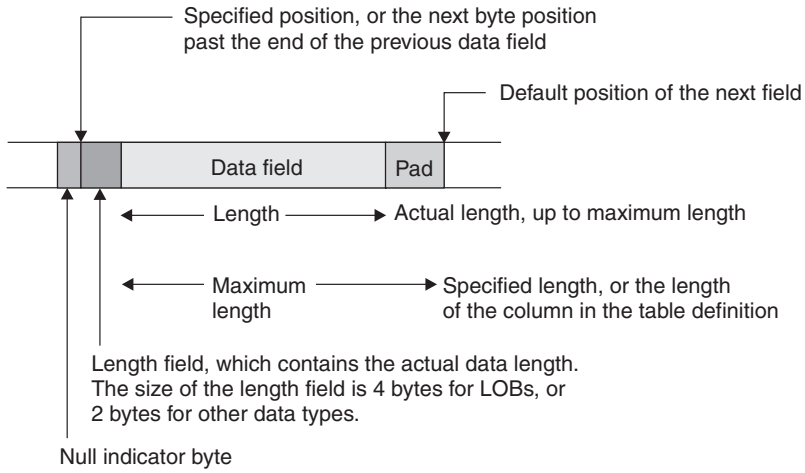


Figure 102. Layout of a nullable varying-length field without the NOPAD option

Output for special values Infinity, sNaN, or NaN

When you run UNLOAD against a DECFLOAT column that contains the special values Infinity, sNaN, or NaN, the output is in uppercase.

Infinity, sNaN, and NaN are unloaded as INFINITY, SNAN, and NAN, respectively.

Unloading delimited files

You can use the DELIMITED option to specify that UNLOAD is to produce an output file in delimited format. All fields in the output data set are either in character string or numeric external format. Each column is separated from the next by a column delimiter, and character strings are marked by character string delimiters.

Recommendation: If a delimited file is to be transferred to or from a platform other than z/OS or between DB2 for z/OS systems that use different EBCDIC or ASCII CCSIDs, use Unicode as the encoding scheme for the delimited file. Using Unicode avoids possible CCSID translation problems.

You are responsible for ensuring that the chosen delimiters are not part of the data in the file. If the delimiters are part of the file's data, unexpected errors can occur.

Restrictions: The following general restrictions apply to the use of delimiters:

- You cannot specify the same character for more than one type of delimiter (COLDEL, CHARDEL, and DECPT).
- You can specify a character constant for a delimiter if the utility control statement is coded in the same encoding scheme as the output file. For example, the utility control statement is coded in Unicode and the output data is also coded in Unicode.
- Use the hex representation for non-default delimiters if the utility control statement is coded in a different encoding scheme than the output file. For example, the utility control statement is coded in Unicode and the output file is coded in EBCDIC. In this case, if you do not use the hex representation for the non-default delimiters, the results can be unpredictable.
- You cannot specify HEADER OBID and ROWID for output fields in delimited output format. Because a header is not allowed, output must be from a single table.
- When you specify the DELIMITED option, the utility ignores the POSITION keyword. The utility overrides field data type specifications according to the specifications of the delimited format. (For example, length values for CHAR, VARCHAR, GRAPHIC, VARGRAPHIC, CLOB, DBCLOB, and BLOB data are the delimited lengths of each field in the output data set, and the utility unloads all numeric types in external format.)
- You cannot specify a binary 0 (zero) for any delimiter.
- No null byte is present for a delimited output file. A null value is indicated by the absence of a cell value where one would normally occur. For example, two successive column delimiters or a missing column at the end of a record indicate a null value.
- You cannot use the default decimal point as a character string delimiter (CHARDEL) or a column string delimiter (COLDEL).
- Shift-in and shift-out characters cannot be specified as EBCDIC MBCS delimiters.
- In the DBCS environment, the pipe character (|) is not supported.
- If the output is coded in ASCII or Unicode, you cannot specify any of the following values for any delimiter: X'0A', X'0D', X'2E'.
- If the output is coded in EBCDIC, you cannot specify any of the following values for any delimiter: X'15', X'0D', X'25'.
- If the output is coded in EBCDIC DBCS or MBCS, you cannot specify any of the following values for character string delimiters: X'0D', X'15', X'25', X'4B'.

The following table lists by encoding scheme the default hex values for the delimiter characters.

Table 130. Default delimiter values for different encoding schemes

Character	EBCDIC SBCS	EBCDIC DBCS/MBCS	ASCII/Unicode SBCS	ASCII/Unicode MBCS
Character string delimiter	X'7F'	X'7F'	X'22'	X'22'
Decimal point character	X'4B'	X'4B'	X'2E'	X'2E'
Column delimiter	X'6B'	X'6B'	X'2C'	X'2C'

In most EBCDIC code pages, the hex values in the previous table represent a double quotation mark(") for the character string delimiter, a period(.) for the decimal point character, and a comma(,) for the column delimiter.

The following table lists by encoding scheme the maximum allowable hex values for any delimiter character.

Table 131. Maximum delimiter values for different encoding schemes

Encoding scheme	Maximum allowable value
EBCDIC SBCS	None
EBCDIC DBCS/MBCS	X'3F' (X'7F', X'4B', X'6B' are also allowed.)
ASCII/Unicode SBCS	None
ASCII/Unicode MBCS	X'7F'

The following table identifies the acceptable data type forms for the delimited file format that the LOAD and UNLOAD utilities use.

Table 132. Acceptable data type forms for delimited files

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file
CHAR, VARCHAR	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. For VARCHAR, length bytes do not precede the data in the string.
GRAPHIC (any type)	A delimited or non-delimited character stream	Data that is unloaded as a delimited character string. For VARGRAPHIC, length bytes do not precede the data in the string.
INTEGER (any type)	A stream of characters that represents a number in EXTERNAL format	Numeric data in external format.
Decimal (any type)	A character stream that represents a number in EXTERNAL format	A string of characters that represents a number.
FLOAT	Representation of a number in the range `-7.2E + 75` to `7.2E + 75`in EXTERNAL format	A string of characters that represents a number in floating-point notation.

Table 132. Acceptable data type forms for delimited files (continued)

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file
BLOB, CLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.
DBCLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.
DATE	A delimited or non-delimited character string that contains a date value in EXTERNAL format	A string of characters that represents a date.
TIME	A delimited or non-delimited character string that contains a time value in EXTERNAL format	A string of characters that represents a time.
TIMESTAMP	A delimited or non-delimited character string that contains a timestamp value in EXTERNAL format	A string of characters that represents a timestamp.
XML	A delimited or non-delimited XML character string	A string of characters that represents an XML document.

Related concepts:

"Loading delimited files" on page 323

Related reference:

Appendix I, "Delimited file format," on page 1203

Specifying TRUNCATE and STRIP options for output data

You can unload certain types of data into output fields that are shorter than the length of the output data. This data truncation occurs only when you explicitly specify the TRUNCATE option. Any CCSID conversion is applied first, and then truncation is applied to encoded data for output.

For bit strings, truncation occurs at a byte boundary. For character type data, truncation occurs at a character boundary (a multi-byte character is not split). If a mixed-character type data is truncated in an output field of fixed size, the truncated string can be shorter than the specified field size. In this case, blanks in the output CCSID are padded to the right. If the output data is in EBCDIC for a mixed-character type field, truncation preserves the SO (shift-out) and the SI (shift-in) characters around a DBCS substring.

The TRUNCATE option of the UNLOAD utility truncates string data, and it has a different purpose than the SQL TRUNCATE scalar function.

For VARCHAR and VARGRAPHIC, and VARBINARY output fields, in addition to the TRUNCATE option, the STRIP option is provided to remove the specified characters, or the leading blanks, the trailing blanks, or both. The strip operation is applied on the encoded data for output. If both the TRUNCATE and STRIP options are specified, the truncation operation is applied first, and then strip is applied. For example, the output for an UNLOAD job in which you specify both the TRUNCATE and STRIP options for a VARCHAR(5) output field is shown in the following table. In this table, an underscore represents a character that is to be

stripped. In all cases, the source string is first truncated to '_ABC_' (a five-character string to fit in the VARCHAR(5) field), and then the strip operation is applied.

Table 133. Results of specifying both the TRUNCATE and STRIP options for UNLOAD

Specified STRIP option	Source string	Truncated string	Output string	Specified *length*
STRIP BOTH	'_ABC_DEF'	'_ABC_'	'ABC'	3
STRIP LEADING	'_ABC_DEF'	'_ABC_'	'ABC_'	4
STRIP TRAILING	'_ABC_DEF'	'_ABC_'	'_ABC'	4

The following control statement shows an example of using the STRIP option.

In the example, STRIP TRAILING '_' is included in the field specification for the TEXT column. The TEXT column contains variable character data with a maximum length of 8 characters, as specified by VARCHAR(8). When the UNLOAD utility unloads the table, all occurrences of the '_' (underscore) character at the end of the data from the TEXT column are stripped from the data.

```
UNLOAD TABLESPACE DB.TS
       PUNCHDDN SYSPUNCH
       UNLDDN UNLDD2
       FROM TABLE TB
         (EMPNO    POSITION(*)  CHAR(6),
          TEXT     POSITION(*)  VARCHAR(8) STRIP TRAILING '_',
          DEPTNO   POSITION(*)  CLOB(4),
          ROWID    POSITION(*)  ROWID,
          LAST_UPDATE   POSITION(*)  TIME EXTERNAL)
```

The following table further illustrates the STRIP option.

Table 134. Example of the results of specifying the STRIP option for UNLOAD

Original data	STRIP specification	Data after stripping	Final length
'_ABC_'	STRIP LEADING '_'	'ABC_'	4
'_ABC_'	STRIP TRAILING '_'	'_ABC'	4
'_ABC_'	STRIP BOTH '_'	'ABC'	3

LOAD statements that are generated by UNLOAD

The UNLOAD utility can generate one or more LOAD utility statements that you can later use to load the unloaded data into either the original table or different tables. The generated LOAD statements are written to the data set that is specified by the PUNCHDDN option. By default, that data set is SYSPUNCH.

To request that UNLOAD generate a LOAD statement, perform one of following actions:

- Include a SYSPUNCH DD statement or SYSPUNCH template in the utility job.
- Specify the PUNCHDDN option with a different DD name or template name and include that DD statement or template in the utility job.

If PUNCHDDN is not specified and the SYSPUNCH DD name does not exist, the LOAD statement is not generated.

If multiple table spaces are to be unloaded and you want UNLOAD to generate a LOAD statement for each table space, specify a physically distinct data set for each table space. To do so, specify the PUNCHDDN option with a template that contains the table space as a variable (&TS.).

Make any necessary changes to the generated LOAD statement. For example, by default, the generated LOAD statement includes WHEN and INTO TABLE specifications that identify the table where the rows are to be reloaded. These specifications are not included if the HEADER NONE option was specified in the UNLOAD statement. If you intend to load the UNLOAD output data into different tables than the original ones, you need to edit the generated LOAD statement.

Related tasks:

"Loading tables with special column types by using generated LOAD statements" on page 316

Related reference:

Chapter 35, "TEMPLATE," on page 789

Unloading compressed data

You can unload compressed rows from an image copy data set only when the dictionary for decompression has been retrieved. If a row is compressed and the dictionary pages have not been read when the row is encountered, the UNLOAD utility ignores this row, issues a warning message, and increments the error count.

About this task

If the error count reaches the limit that is specified by the MAXERR option, UNLOAD terminates with an error message.

If the image copy data set is an incremental copy or a copy of pieces that does not contain a dictionary, the FROMCOPYDDN option can be used for a DD name to concatenate the data set with the corresponding full image copy that contains the dictionary. If SYSTEMPAGES YES is used, a dictionary will always be available in the incremental copies or pieces.

Field specification errors

If the UNLOAD utility detects any inconsistency relating to the field specification, DB2 issues an error message. For example, the UNLOAD utility might detect a data conversion problem or an encoding problem that occurs during the unloading of a row.

If the MAXERR option specifies a number that is greater than zero, the UNLOAD utility continues processing until the total number of the records in error reaches the specified MAXERR number. DB2 issues one message for each record in error and does not unload the record.

Termination or restart of UNLOAD

You can terminate and restart an UNLOAD utility job.

If you terminate UNLOAD by using the **TERM UTILITY** command during the unload phase, the output records are not erased. The output data set remains incomplete until you either delete it or restart the utility job.

When the source is one or more table spaces, you can restart the UNLOAD job at the partition level or at the table space level when data is unloaded from multiple table spaces by using the LIST option. When you restart a terminated UNLOAD job, processing begins with the table spaces or partitions that had not yet been completed. For a table space or partitions that were being processed at termination, UNLOAD resets the output data sets and processes those table space or partitions again.

When the source is one or more image copy data sets (when FROMCOPY or FROMCOPYDDN is specified), UNLOAD always starts processing from the beginning.

Related tasks:

"Restarting an online utility" on page 52

Sample UNLOAD control statements

Use the sample control statements as models for developing your own UNLOAD control statements.

Example 1: Unloading all columns of specified rows

The control statement specifies that all columns of rows that meet the following criteria are to be unloaded from table DSN8810.EMP in table space DSN8D11A.DSN8S71E:

- The value in the WORKDEPT column is D11.
- The value in the SALARY column is greater than 25 000.

```
//STEP1    EXEC DSNUPROC,UID='SMPLUNLD',UTPROC='',SYSTEM='DSN'
//SYSREC   DD DSN=USERID.SMPLUNLD.SYSREC,
//         DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(TRK,(2,1))
//SYSPUNCH DD DSN=USERID.SMPLUNLD.SYSPUNCH,
//         DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(TRK,(1,1))
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
  UNLOAD TABLESPACE DSN8D11A.DSN8S81E
    FROM TABLE DSN8B10.EMP
    WHEN (WORKDEPT = 'D11' AND SALARY > 25000)
```

Figure 103. Example of unloading all columns of specified rows

Example 2: Unloading specific columns by using a field specification list

The following control statement specifies that columns EMPNO, LASTNAME, and SALARY are to be unloaded, in that order, for all rows that meet the specified conditions. These conditions are specified in the WHEN clause and are the same as those conditions in example 1. The SALARY column is to be unloaded as type DECIMAL EXTERNAL. The NOPAD option indicates that variable-length fields are to be unloaded without any padding.

```
UNLOAD TABLESPACE DSN8D11A.DSN8S81E NOPAD
  FROM TABLE DSN8B10.EMP
    (EMPNO, LASTNAME, SALARY DECIMAL EXTERNAL)
  WHEN (WORKDEPT = 'D11' AND SALARY > 25000)
```

The output from this example might look similar to the following output:

```
000060@@STERN#   32250.00
000150@@ADAMSON#   25280.00
000200@@BROWN#   27740.00
000220@@LUTZ#   29840.00
200220@@JOHN#   29840.00
```

In this output:

- '@@' before the last name represents the 2-byte binary field that contains the length of the VARCHAR field LASTNAME (for example, X'0005' for STERN).
- '#' represents the NULL indicator byte for the nullable SALARY field.
- Because the SALARY column is declared as DECIMAL (9,2) on the table, the default output length of the SALARY field is 11 (9 digits + sign + decimal point), not including the NULL indicator byte.
- LASTNAME is unloaded as a variable-length field because the NOPAD option is specified.

Example 3: Unloading data from an image copy

The FROMCOPY option in the following control statement specifies that data is to be unloaded from a single image copy data set, JUKWU111.FCOPY1.STEP1.FCOPY1.

PUNCHDDN SYSPUNCH specifies that the UNLOAD utility is to generate LOAD utility control statements and write them to the data set that is defined by the SYSPUNCH DD statement; SYSPUNCH is the default. UNLDDN SYSREC specifies that the data is to be unloaded to the data set that is defined by the SYSREC DD statement; SYSREC is the default.

```
UNLOAD TABLESPACE DBKW1101.TPKW1101
           FROMCOPY JUKWU111.FCOPY1.STEP1.FCOPY1
           PUNCHDDN SYSPUNCH UNLDDN SYSREC
```

Example 4: Unloading a sample of rows and specifying a header.

The following control statement specifies that a sample of rows is to be unloaded from table ADMF001.TBKW1605. Unloading a sample of rows is useful for building a test system. The SAMPLE option indicates that 75% of the rows are to be sampled. The HEADER option indicates that the string 'sample' is to be used as the header field in the output file. The PUNCHDDN option indicates that UNLOAD is to generate LOAD utility control statements and write them to the SYSPUNCH data set, which is the default. UNLOAD specifies the header field as a criterion in the WHEN clause of these LOAD statements.

```
UNLOAD TABLESPACE DBKW1603.TPKW1603
            PUNCHDDN SYSPUNCH UNLDDN SYSREC
            FROM TABLE ADMF001.TBKW1605
              HEADER CONST 'sample'
              SAMPLE 75
```

Example 5: Unloading data from two tables in a segmented table space

The following control statement specifies that data from table ADMF001.TBKW1504 and table ADMF001.TBKW1505 is to be unloaded from the segmented table space DBKW1502.TSKW1502. The PUNCHDDN option indicates that UNLOAD is to generate LOAD utility control statements and write them to

the SYSPUNCH data set, which is the default. The UNLDDN option specifies that the data is to be unloaded to the data set that is defined by the SYSREC DD statement, which is also the default.

```
UNLOAD TABLESPACE DBKW1502.TSKW1502
           PUNCHDDN SYSPUNCH UNLDDN SYSREC
            FROM TABLE ADMF001.TBKW1504
            FROM TABLE ADMF001.TBKW1505
```

Example 6: Unloading data in parallel from a partitioned table space

The UNLOAD control statement specifies that data from table TCRT.TTBL is to be unloaded to data sets that are defined by the UNLDDS template. These data sets are to be dynamically allocated and named according to the naming convention that is defined by the DSN option of the TEMPLATE utility control statement. This naming convention indicates that a data set is to be allocated for each table space partition.

Assume that table space TDB1.TSP1, which contains table TCRT.TTBL, has three partitions. Because the table space is partitioned and each partition is associated with an output data set that is defined by the UNLDDS template, the UNLOAD job runs in parallel in a multi-processor environment. The number of parallel tasks are determined by the number of available processors.

```
//STEP1    EXEC DSNUPROC,UID='SMPLUNLD',UTPROC='',SYSTEM='DSN'
//SYSPUNCH DD DSN=USERID.SMPLUNLD.SYSPUNCH,
//         DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(TRK,(1,1))
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
  TEMPLATE UNLDDS   DSN &USERID..SMPLUNLD.&TS..P&PART.
           UNIT SYSDA  DISP (NEW,CATLG,CATLG) SPACE (2,1) CYL
  UNLOAD TABLESPACE TDB1.TSP1
    UNLDDN UNLDDS
    FROM TABLE TCRT.TTBL
```

Figure 104. Example of unloading data in parallel from a partitioned table space

Assume that the user ID is USERID. This UNLOAD job creates the following three data sets to store the unloaded data:

- USERID.SMPLUNLD.TSP1.P00001 ... contains rows from partition 1.
- USERID.SMPLUNLD.TSP1.P00002 ... contains rows from partition 2.
- USERID.SMPLUNLD.TSP1.P00003 ... contains rows from partition 3.

Example 7: Using a LISTDEF utility statement to specify partitions to unload

The UNLOAD control statement specifies that data that is included in the UNLDLIST list is to be unloaded. UNLDLIST is defined in the LISTDEF utility control statement and contains partitions one and three of table space TDB1.TSP1. The LIST option of the UNLOAD statement specifies that the UNLOAD utility is to use this list.

The data is to be unloaded to data sets that are defined by the UNLDDS template.

```
//SAMPJOB  JOB ...
//STEP1    EXEC DSNUPROC,UID='SMPLUNLD',UTPROC='',SYSTEM='DSN'
//SYSPUNCH DD DSN=USERID.SMPLUNLD.SYSPUNCH,
//         DISP=(NEW,CATLG,CATLG),
//         UNIT=SYSDA,SPACE=(TRK,(1,1))
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
  LISTDEF  UNLDLIST
           INCLUDE  TABLESPACE TDB1.TSP1 PARTLEVEL(1)
           INCLUDE  TABLESPACE TDB1.TSP1 PARTLEVEL(3)
  TEMPLATE UNLDDS   DSN &USERID..SMPLUNLD.&TS..P&PART.
           UNIT SYSDA  DISP (NEW,CATLG,CATLG) SPACE (2,1) CYL
  UNLOAD LIST UNLDLIST              -- LIST name
    UNLDDN UNLDDS                   -- TEMPLATE name
```

Figure 105. Example of using a LISTDEF utility statement to specify partitions to unload

Assume that the user ID is USERID. This UNLOAD job creates the following two data sets to store the unloaded data:

- USERID.SMPLUNLD.TSP1.P00001 ... contains rows from partition 1.
- USERID.SMPLUNLD.TSP1.P00003 ... contains rows from partition 3.

Example 8: Unloading multiple table spaces by using LISTDEF

The UNLOAD control statement specifies that data from multiple table spaces is to be unloaded. These table spaces are specified in the LISTDEF utility control statement. Assume that the database TDB1 contains two table spaces that can be expressed by the pattern-matching string 'TSP*', (for example, TSP1 and TSP2). These table spaces are both included in the list named UNLDLIST, which is defined in the LISTDEF statement. The LIST option of the UNLOAD statement specifies that the UNLOAD utility is to use this list.

The UNLDDN option specifies that the data is to be unloaded to data sets that are defined by the UNLDDS template. The PUNCHDDN option specifies that UNLOAD is to generate LOAD utility control statements and write them to the data sets that are defined by the PUNCHDS template.

```
//SAMPJOB  JOB ...
//STEP1    EXEC DSNUPROC,UID='SMPLUNLD',UTPROC='',SYSTEM='DSN'
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
  LISTDEF  UNLDLIST
           INCLUDE  TABLESPACE TDB1.TSP*
  TEMPLATE UNLDDS   DSN &USERID..SMPLUNLD.&TS.
           UNIT SYSDA  DISP (NEW,CATLG,CATLG) SPACE (2,1) CYL
  TEMPLATE PUNCHDS  DSN &USERID..SMPLPUNC.&TS.
           UNIT SYSDA  DISP (NEW,CATLG,CATLG) SPACE (1,1) CYL
  UNLOAD LIST UNLDLIST
    PUNCHDDN PUNCHDS              -- TEMPLATE name
    UNLDDN   UNLDDS               -- TEMPLATE name
```

Figure 106. Example of unloading multiple table spaces

Assume that the user ID is USERID. This UNLOAD job creates the following two data sets to store the unloaded data:

- USERID.SMPLUNLD.TSP1 ... contains rows from table space TDB1.TSP1.
- USERID.SMPLUNLD.TSP2 ... contains rows from table space TDB1.TSP2.

Example 9: Unloading data into a delimited file.

The control statement specifies that data from the specified columns (RECID, CHAR7SBCS, CHAR7BIT, VCHAR20, VCHAR20SBCS, VCHAR20BIT) in table TBQB0501 is to be unloaded into a delimited file. This output format is indicated by the DELIMITED option. The POSITION(*) option indicates that each field in the output file is to start at the first byte after the last position of the previous field.

The column delimiter is specified by the COLDEL option as a semicolon (;), the character string delimiter is specified by the CHARDEL option as a pound sign (#), and the decimal point character is specified by the DECPT option as an exclamation point (!).

PUNCHDDN SYSPUNCH specifies that UNLOAD is to generate LOAD utility control statements and store them in the SYSPUNCH data set, which is the default. UNLDDN SYSREC indicates that the data is to be unloaded to the SYSREC data set, which is the default.

The EBCDIC option indicates that all output character data is to be in EBCDIC.

```
//*
//STEP3    EXEC DSNUPROC,UID='JUQBU105.UNLD1',
//         UTPROC='',
//         SYSTEM='SSTR'
//UTPRINT  DD SYSOUT=*
//SYSREC   DD DSN=JUQBU105.UNLD1.STEP3.TBQB0501,DISP=(MOD,DELETE,CATLG),
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSPUNCH DD DSN=JUQBU105.UNLD1.STEP3.SYSPUNCH
//         DISP=(MOD,CATLG,CATLG)
//         UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSIN    DD*
    UNLOAD TABLESPACE DBQB0501.TSQB0501
         DELIMITED CHARDEL '#' COLDEL ';' DECPT '!'
         PUNCHDDN SYSPUNCH
         UNLDDN SYSREC EBCDIC
         FROM TABLE ADMF001.TBQB0501
          (RECID       POSITION(*) CHAR,
            CHAR7SBCS   POSITION(*) CHAR,
           CHAR7SBIT   POSITION(*) CHAR(7),
           VCHAR20     POSITION(*) VARCHAR,
           VCHAR20SBCS POSITION(*) VARCHAR,
           VCHAR20BIT  POSITION(*) VARCHAR)
 /*
```

Figure 107. Example of unloading data into a delimited file.

Example 10: Converting character data

For this example, assume that table DSN8810.DEMO_UNICODE contains character data in Unicode. The UNLOAD control statement specifies that the utility is to unload the data in this table as EBCDIC data.

```
UNLOAD
  EBCDIC
  TABLESPACE DSN8D81E.DSN8S81U
  FROM TABLE DSN8810.DEMO_UNICODE
```

Figure 108. Example of unloading Unicode table data into EBCDIC

Example 11: Unloading LOB data to a file

The UNLOAD control statement specifies that the utility is to unload data from table DSN8910.EMP_PHOTO_RESUME into the data set that is identified by the SYSREC DD statement. Data in the EMPNO field is six bytes of character data, as indicated by the CHAR(6) option, and is unloaded directly into the SYSREC data set. Data in the RESUME column is CLOB data as indicated by the CLOBF option. This CLOB data is to be unloaded to the files identified by the LOBFRV template, which is defined in the preceding TEMPLATE statement. If these files do not already exist, DB2 creates them. The names of these files are stored in the SYSREC data set. The length of the file name to be stored in this data set can be up to 255 bytes as specified by the VARCHAR option.

```
TEMPLATE LOBFRV DSN 'UNLDTEST.&DB..&TS..RESUME'
                DSNTYPE(PDS) UNIT(SYSDA)

UNLOAD DATA
  FROM TABLE DSN8910.EMP_PHOTO_RESUME
  (EMPNO  CHAR(6),
   RESUME VARCHAR(255) CLOBF LOBFRV)
 SHRLEVEL CHANGE
```

Figure 109. Example of unloading LOB data into a file

Example 12: Unloading data from clone tables

The UNLOAD control statement specifies that the utility is to unload data from only clone tables in the specified table spaces. The PUNCHDDN option specifies that the SYSPUNCH data set is to receive the LOAD utility control statements that the UNLOAD utility generates.

```
UNLOAD TABLESPACE DBKQRE01.TPKQRE01
        FROM TABLE ADMF001.TBKQRE01_CLONE
        PUNCHDDN SYSPUNCH UNLDDN SYSREC
        CLONE
```

Part 3. DB2 stand-alone utilities

The stand-alone utilities run as batch jobs that are independent of DB2. The only way to run these utilities is to use JCL.

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Chapter 37. Invoking stand-alone utilities

To invoke a stand-alone utility, you must use JCL. Some stand-alone utilities read the utility control statements from an input stream; other utilities obtain the function definitions from JCL EXEC PARM parameters.

Before you begin

Make sure that you are authorized to run the utility that you want to invoke. To check the required authorization, see the following information for the utility that you want to invoke:

- Chapter 38, "DSNJCNVB," on page 891
- Chapter 39, "DSNJCNVT," on page 893
- Chapter 40, "DSNJLOGF (preformat active log)," on page 895
- Chapter 41, "DSNJU003 (change log inventory)," on page 897
- Chapter 42, "DSNJU004 (print log map)," on page 923
- Chapter 43, "DSN1COMP," on page 941
- Chapter 44, "DSN1COPY," on page 953
- Chapter 45, "DSN1LOGP," on page 979
- Chapter 46, "DSN1PRNT," on page 999
- Chapter 47, "DSN1SDMP," on page 1011

Procedure

To invoke a stand-alone utility:

1. Prepare the necessary data sets. For information about the data sets that are required for the utility that you want to invoke, see the following information for that utility:
   - Chapter 38, "DSNJCNVB," on page 891
   - Chapter 39, "DSNJCNVT," on page 893
   - Chapter 40, "DSNJLOGF (preformat active log)," on page 895
   - Chapter 41, "DSNJU003 (change log inventory)," on page 897
   - Chapter 42, "DSNJU004 (print log map)," on page 923
   - Chapter 43, "DSN1COMP," on page 941
   - "Data sets that DSN1COPY uses" on page 963
   - Chapter 45, "DSN1LOGP," on page 979
   - Chapter 46, "DSN1PRNT," on page 999
   - Chapter 47, "DSN1SDMP," on page 1011
2. Invoke the utility by creating a JCL job with the following information:
   - Specify the utility name on the EXEC statement, in the PGM parameter.
   - Specify the utility options as follows:

     DSN1COMP, DSN1COPY, and DSN1PRNT
     For these utilities, specify the utility options on the EXEC statement, in the PARM parameter. For more information about how to specify

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these options and sample JCL for each utility, see "Specifying options for stand-alone utilities by using the JCL EXEC PARM parameter."

DSNJU003, DSNJU004, DSN1LOGP, andDSN1SDMP
For these utilities, create a utility control statement in an in-stream data set. For more information about these utility control statements, the DD name to use for the in-stream data set, and sample JCL for each utility, see "Stand-alone utility control statements" on page 889.

DSNJCNVB, DSNJCNVT, and DSNJLOGF
These utilities do not have any options. For sample JCL for these utilities, see the following information:

- Chapter 38, "DSNJCNVB," on page 891
- Chapter 39, "DSNJCNVT," on page 893
- Chapter 40, "DSNJLOGF (preformat active log)," on page 895

Related concepts:

Chapter 1, "Types of DB2 utilities," on page 3

What is JCL? (z/OS basic skills)

JCL DD statement: ddnames that are reserved for specific uses (z/OS basic skills)

Coding JCL: Data set types and name syntax (z/OS Basic Skills)

Specifying options for stand-alone utilities by using the JCL EXEC PARM parameter

Use the EXEC PARM parameter to specify function options for the following stand-alone utilities: DSN1COMP, DSN1COPY, and DSN1PRNT.

Procedure

To specify options for stand-alone utilities by using the JCL EXEC PARM parameter:

- Ensure that the parameters that you specify obey the following JCL EXEC PARM parameter specification rules:
  - Enclose multiple subparameters in single quotation marks or parentheses and separate the subparameters with commas, as in the following example:

    ```
    //name   EXEC PARM='ABC,...,XYZ'
    ```
  - Ensure that the total length of the parameter specification does not exceed 100 characters.
  - Do not use blanks within the parameter specification.
- To specify the parameter across multiple lines:
  1. Enclose it in parentheses.
  2. End the first line with a subparameter, followed by a comma.
  3. Continue the subparameters on the next line, beginning before column 17.

  The following example shows a parameter that spans multiple lines:

  ```
  //stepname  EXEC PARM=(ABC,...LMN,
             OPQ,...,XYZ)
  ```

Example

For sample JCL, see the following information:

- "Sample DSN1COMP control statements" on page 948
- "Sample DSN1COPY control statements" on page 974
- "Sample DSN1PRNT control statements" on page 1007

Related reference:

EXEC PARM Parameter (MVS JCL Reference)

Stand-alone utility control statements

Utility control statements include parameters that define the function that a utility job performs. Only some stand-alone utilities require utility control statements. For the other stand-alone utilities, you specify the utility parameters in the PARM parameter of the EXEC statement.

The following table lists the stand-alone utilities that read utility control statements from an in-stream data set. Use the listed DD name for the in-stream data set.

Table 135. Stand-alone utilities that read utility control statements

Utility	DD name
DSNJU003 (change log inventory)	SYSIN
DSNJU004 (print log map)	SYSIN (optional)
DSN1LOGP	SYSIN
DSN1SDMP	SDMPIN

The statements must conform to the following rules:

- The logical record length (LRECL) must be 80 characters. Columns 73 through 80 are ignored.
- The records are concatenated into a single stream before they are parsed. No concatenation character is necessary.
- The SYSIN stream can contain multiple utility control statements.

For sample JCL with utility control statements, see the following information:

- "Sample DSNJU003 control statements" on page 919
- "Sample DSNJU004 control statement" on page 925
- "Sample DSN1LOGP control statements" on page 990
- "Sample DSN1SDMP control statements" on page 1019

Related concepts:

JCL DD statement: ddnames that are reserved for specific uses (z/OS basic skills)

Coding JCL: Data set types and name syntax (z/OS Basic Skills)

Related tasks:

"Specifying options for stand-alone utilities by using the JCL EXEC PARM parameter" on page 888

Chapter 38. DSNJCNVB

The DSNJCNVB stand-alone conversion utility converts the bootstrap data set (BSDS) so that it can support up to 10,000 archive log volumes and 93 active log data sets per log copy.

Environment

Execute the DSNJCNVB utility as a batch job only when DB2 is not running.

Authorization required

The authorization ID of the DSNJCNVB job must have the requisite RACF authorization.

Prerequisite actions

If you have migrated to a new version of DB2, you need to create a larger BSDS before converting it. For a new installation, you do not need to create a larger BSDS. DB2 provides a larger BSDS definition in installation job DSNTIJIN; however, if you want to convert the BSDS, you must still run DSNJCNVB.

Required and optional data sets

DSNJCNVB recognizes DD statements with the following DD names:

SYSUT1
Specifies the BSDS copy 1 data set that DSNJCNVB is to use as input. This statement is required.

SYSUT2
Specifies the BSDS copy 2 data set that DSNJCNVB is to use as input. This statement is optional.

Specify this statement if you are using dual BSDSs and you want to convert both with a single execution of DSNJCNVB. You can run DSNJCNVB separately for each copy.

SYSPRINT
Specifies a data set or print spool class for print output. This statement is required. The logical record length (LRECL) is 125.

Running DSNJCNVB

Use the following EXEC statement to execute this utility:

```
//EXEC   PGM=DSNJCNVB
```

Sample DSNJCNVB control statement

The following statements specify that DSNJCNVB is to convert the BSDS so that it can manage up to 10 000 archive log volumes and 93 active log data sets per log copy. The SYSUT1 and SYSUT2 statements identify the bootstrap data sets. Only the SYSUT1 statement is required. The SYSUT2 statement is optional. Specify SYSUT2 only if you are using dual BSDSs and you want to convert both with a single execution of DSNJCNVB.

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```
//DSNJCNVB EXEC PGM=DSNJCNVB
//STEPLIB  DD  DISP=SHR,DSN=DSNC810.SDSNEXIT
//         DD  DISP=SHR,DSN=DSNC810.SDSNLOAD
//SYSUT1   DD  DISP=OLD,DSN=DSNC810.BSDS01
//SYSUT2   DD  DISP=OLD,DSN=DSNC810.BSDS02
//SYSPRINT DD  SYSOUT=*
```

DSNJCNVB output

The following example shows sample DSNJCNVB output:

```
CONVERSION OF BSDS DATA SET - COPY 1, DSN=DSNC810.BSDS01
         SYSTEM TIMESTAMP   - DATE=2003.199  LTIME= 9:40:58.74
         UTILITY TIMESTAMP  - DATE=2003.216  LTIME=14:26:02.21
         PREVIOUS HIKEY     - 04000053
         NEW HIKEY          - 040002F0
         RECORDS ADDED      - 669
DSNJ260I  DSNJCNVB BSDS CONVERSION FOR DDNAME=SYSUT1 COMPLETED SUCCESSFULLY
DSNJ200I  DSNJCNVB CONVERT BSDS UTILITY PROCESSING COMPLETED SUCCESSFULLY
```

Related tasks:

Add a second BSDS (DB2 Installation and Migration)

Chapter 39. DSNJCNVT

The DSNJCNVT stand-alone conversion utility converts the bootstrap data set (BSDS) records that are necessary to support 10-byte RBA and LRSN fields.

Running DSNJCNVT is optional and can be done any time after migrating to Version 11 new-function mode. Conversion is required during installation if the RBA or LRSN is approaching the end of the range. For a data-sharing installation, if the LRSN is approaching the end of the range, the BSDS of each member can be converted one at a time. If the RBA or LRSN is approaching the end of the range, the database objects also need to be converted; otherwise, they become read-only when the end of the range is reached.

Environment

Run the DSNJCNVT utility as a batch job only when DB2 is not running.

Your DB2 subsystem must be in new-function mode to convert the BSDS.

Authorization required

The authorization ID of the DSNJCNVT job must have the required RACF authorization and read/write access to the new BSDSs and read access to the old BSDSs.

Required and optional data sets

DSNJCNVT recognizes DD statements with the following DD names:

SYSUT1
Specifies the old BSDS that is to be converted. This statement is required.

SYSUT2
Specifies the second copy of the old BSDS that is to be converted. This statement is optional.

SYSUT3
Specifies the new, converted BSDS. This statement is required.

SYSUT4
Specifies the second copy of the converted BSDS. This statement is required if the installation uses dual BSDSs; otherwise, it is optional.

SYSPRINT
Contains the output messages from the conversion utility. This statement is required.

Running DSNJCNVT

Use the following EXEC statement to run this utility:

```
//EXEC   PGM=DSNJCNVT
```

Considerations for running DSNJCNVT

- The DB2 subsystem that owns the BSDSs that are to be converted must be stopped. DSNJCNVT is a stand-alone utility.

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- In a data-sharing environment, allow DB2 utilities that read the logs of peer members to finish before converting the BSDSs.
- In a data-sharing environment, stop data replication products before the conversion to ensure that the old BSDSs can be successfully renamed and replaced by the converted BSDSs. The recommended procedure is to stop the replication product first and then stop the DB2 system that is to have its BSDSs converted. This procedure allows sharing systems to deallocate the BSDSs when the state of the member changes to inactive.
- The RACF user ID that is running DSNJCNVT must have read/write access to the new BSDSs and read access to the old BSDSs.
- The DB2 subsystem that owns the BSDS that is to be converted must start after the data sharing group was migrated to Version 11 new-function mode.
- Conversion to the new BSDS format is required to write new format log records and remove the 6-byte RBA and LRSN limits.

Sample DSNJCNVT control statement

The following statements specify that DSNJCNVT is to convert the BSDS that is needed to support 10-byte RBA and LRSN fields.

```
//CONVERT EXEC PGM=DSNJCNVT,REGION=64M
//SYSUT1   DD  DSN=DB2A.OLD.BSDS01,DISP=SHR
//SYSUT2   DD  DSN=DB2A.OLD.BSDS02,DISP=SHR
//SYSUT3   DD  DSN=DB2A.BSDS01,DISP=OLD
//SYSUT4   DD  DSN=DB2A.BSDS02,DISP=OLD
//SYSPRINT DD  SYSOUT=*
```

You can view another example of using DSNJCNVT in job DSNTIJCB in *prefix*.SDSNSAMP.

DSNJCNVT output

The following example shows sample DSNJCNVT output:

```
CRCR convert started
DSNJ200I DSNJCNVT CONVERT UTILITY PROCESSING COMPLETED SUCCESSFULLY
FOR MEMBER 'xxxxxxxx'
```

Chapter 40. DSNJLOGF (preformat active log)

When writing to an active log data set for the first time, DB2 must preformat a VSAM control area before writing the log records. The DSNJLOGF stand-alone utility avoids this delay by preformatting the active log data sets before bringing them online to DB2.

The following EXEC statement is used to invoke DSNJLOGF:

```
//stepname EXEC PGM=DSNJLOGF
```

Environment

Run DSNJLOGF as a z/OS job.

Required and optional data sets

All SYSUT*x* DD statements are optional, but at least one must be specified.

DSNJLOGF recognizes DD statements with the following DD names.

SYSUT0
Defines the newly defined active log data set that is to be preformatted. The data set must be an empty VSAM linear data set and less than four gigabytes in size.

SYSUT1
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT2
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT3
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT4
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT5
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT6
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT7
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSUT8
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

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SYSUT9
Defines a newly defined active log data set that is to be preformatted. This statement is optional.

SYSPRINT
Defines the print spool class or data set for print output. The logical record length (LRECL) is 132.

Sample DSNJLOGF control statement

The control statements in the following figure specify that DSNJLOGF is to preformat the active log data sets that are identified by the DD statements.

```
//MULTFMT  EXEC PGM=DSNJLOGF,REGION=64M
//SYSPRINT  DD SYSOUT=*
//SYSUT0    DD DSN=DSNTEMP.LOGCOPY1.DS00,DISP=SHR
//SYSUT1    DD DSN=DSNTEMP.LOGCOPY1.DS01,DISP=SHR
//SYSUT2    DD DSN=DSNTEMP.LOGCOPY1.DS02,DISP=SHR
//SYSUT3    DD DSN=DSNTEMP.LOGCOPY1.DS03,DISP=SHR
//SYSUT4    DD DSN=DSNTEMP.LOGCOPY1.DS04,DISP=SHR
//SYSUT5    DD DSN=DSNTEMP.LOGCOPY1.DS05,DISP=SHR
//SYSUT6    DD DSN=DSNTEMP.LOGCOPY1.DS06,DISP=SHR
//SYSUT7    DD DSN=DSNTEMP.LOGCOPY1.DS07,DISP=SHR
//SYSUT8    DD DSN=DSNTEMP.LOGCOPY1.DS08,DISP=SHR
//SYSUT9    DD DSN=DSNTEMP.LOGCOPY1.DS09,DISP=SHR
```

Figure 110. Sample DSNJLOGF control statement

DSNJLOGF output

The following sample shows the DSNJLOGF output for the second data set in the previous sample control statement shown above.

```
DSNJ991I DSNJLOGF START OF LOG DATASET PREFORMAT FOR JOB LOGFRMT  STEP1
DSNJ992I DSNJLOGF LOG DATA SET NAME = DSNC110.LOGCOPY1.DS01
DSNJ996I DSNJLOGF LOG PREFORMAT COMPLETED SUCCESSFULLY, 00015000
         RECORDS FORMATTED
```

Chapter 41. DSNJU003 (change log inventory)

The DSNJU003 stand-alone utility changes the bootstrap data sets (BSDSs).

You can use the utility to:

- Add or delete active or archive log data sets
- Add or delete checkpoint records
- Create a conditional restart control record to control the next start of the DB2 subsystem
- Change the VSAM catalog name entry in the BSDS
- Modify the communication record in the BSDS
- Modify the value for the highest-written log RBA value (relative byte address within the log) or the highest-offloaded RBA value
- Deactivate a member of a data sharing group
- Destroy a member from a data sharing group
- Reactivate a deactivated member of a data sharing group

Environment

Execute the change log inventory utility only as a batch job when DB2 is not running. Changing a BSDS for a data-sharing member by using DSNJU003 might cause a log read request from another data-sharing member to fail. The failure occurs only if the second member tries to access the changed BSDS before the first member is started.

Authorization required

The authorization ID of the DSNJU003 job must have the requisite RACF authorization.

Required and optional data sets

DSNJU003 recognizes DD statements with the following DD names:

SYSUT1
Specifies and allocates the bootstrap data set. This statement is required.

SYSUT2
Specifies and allocates a second copy of the bootstrap data set. This statement is required if you use dual BSDSs.

Dual BSDSs and DSNJU003: With each execution of DSNJU003, the BSDS timestamp field is updated with the current system time. If you run DSNJU003 separately for each copy of a dual copy BSDS, the timestamp fields are not synchronized, and DB2 fails at startup. If you change the contents of the BSDS copy by running DSNJU003, DB2 issues error message DSNJ122I. Therefore, if you use DSNJU003 to update dual copy BSDSs, update both BSDSs within a single execution of DSNJU003.

SYSPRINT
Specifies a data set for print output. This statement is required. The logical record length (LRECL) is 125.

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SYSIN
Specifies the input data set for statements. This statement is required. The logical record length (LRECL) is 80.

Running DSNJU003

Execute the utility with the following statement, which can be included only in a batch job:

```
//EXEC   PGM=DSNJU003
```

Syntax and options of the DSNJU003 control statement

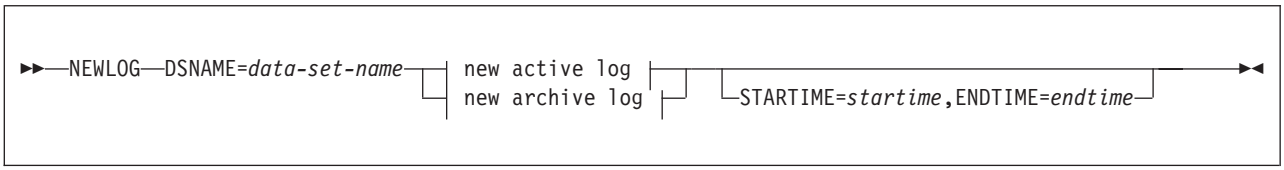
The DSNJU003 utility control statement, with its multiple options, defines the function that the utility job performs.

DSNJU003 uses multiple statements that you submit in separate jobs. The statements are:

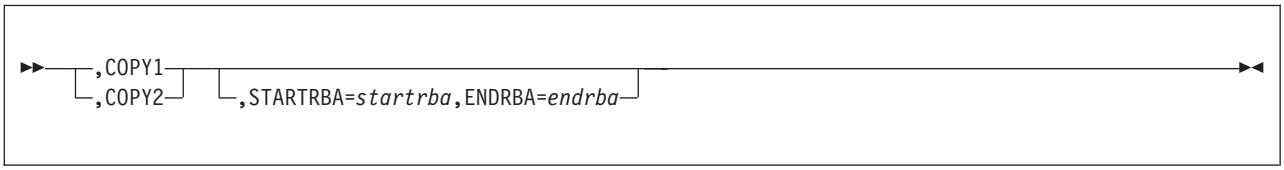
- NEWLOG
- DELETE
- CRESTART
- NEWCAT
- DDF
- CHECKPT
- HIGHRBA
- DELMBR
- RSTMBR

DSNJU003 (change log inventory) syntax diagram

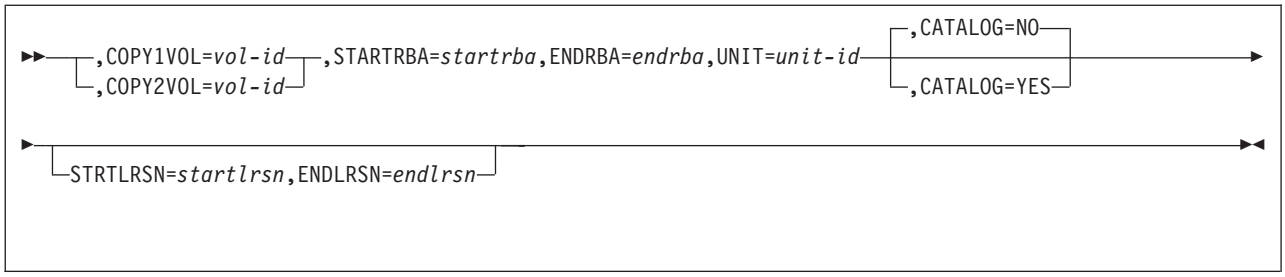
NEWLOG statement



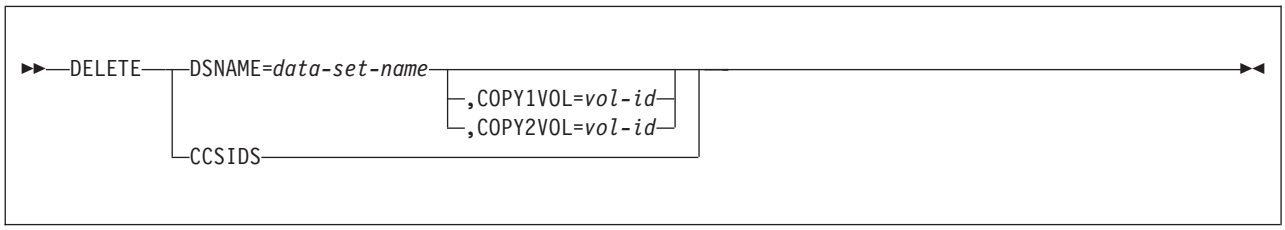
new active log:



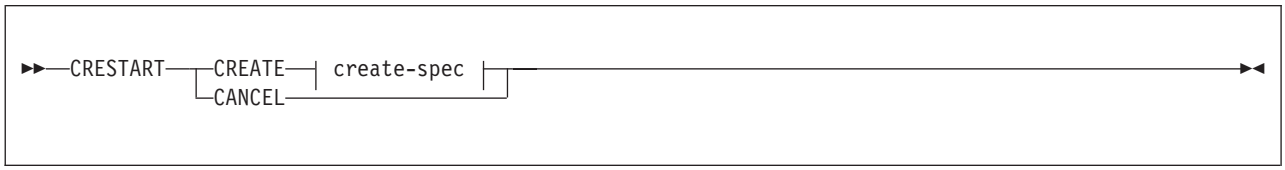
new archive log:



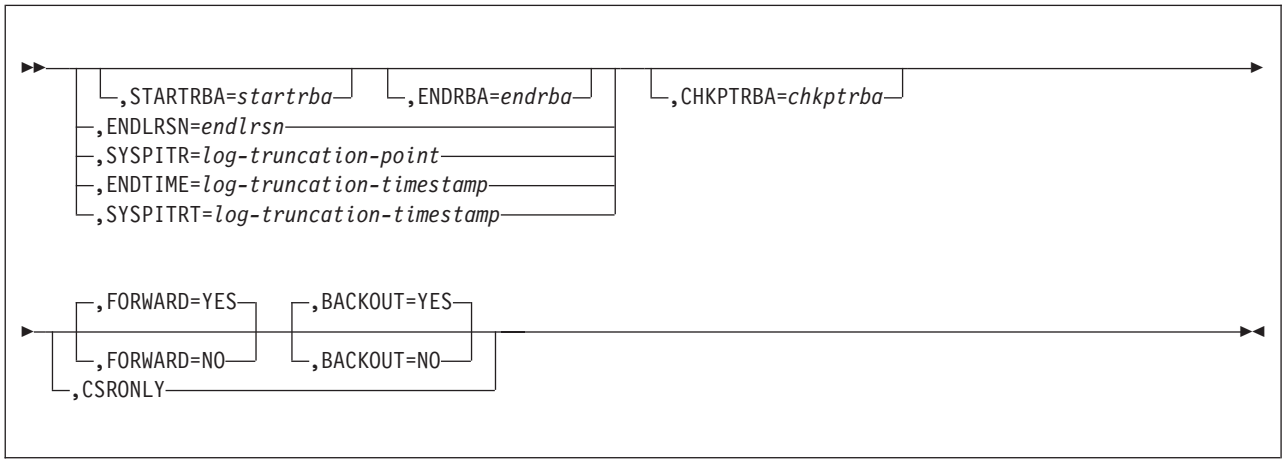
DELETE statement



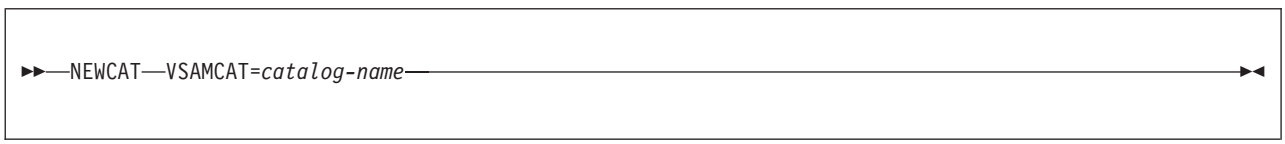
CRESTART statement



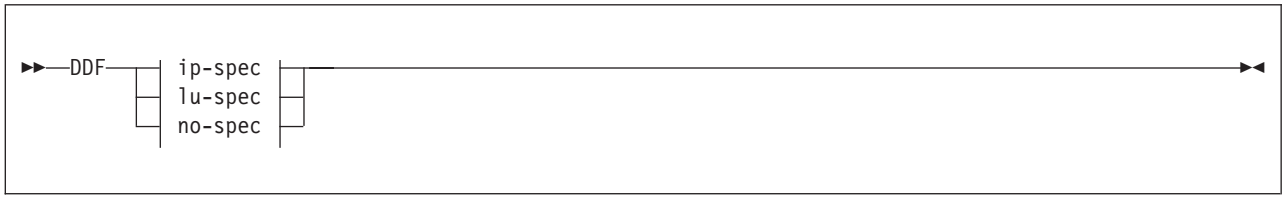
create-spec:



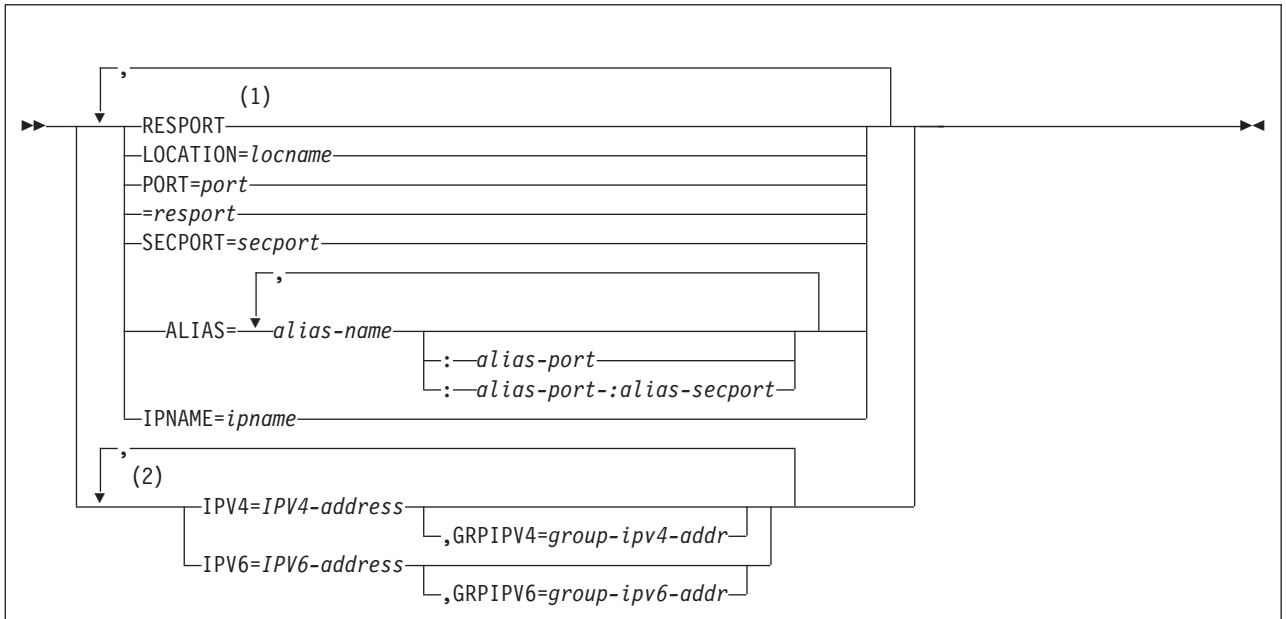
NEWCAT statement



DDF statement



ip-spec:

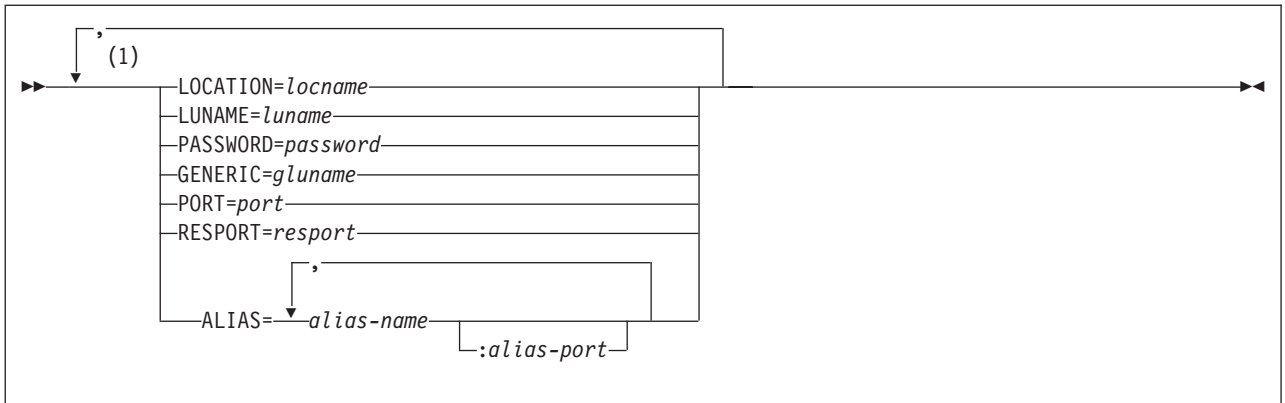


Notes:

1 You can specify each option (such as LOCATION or PORT) only once.

2 You can specify each option (IPV4 and IPV6) only once.

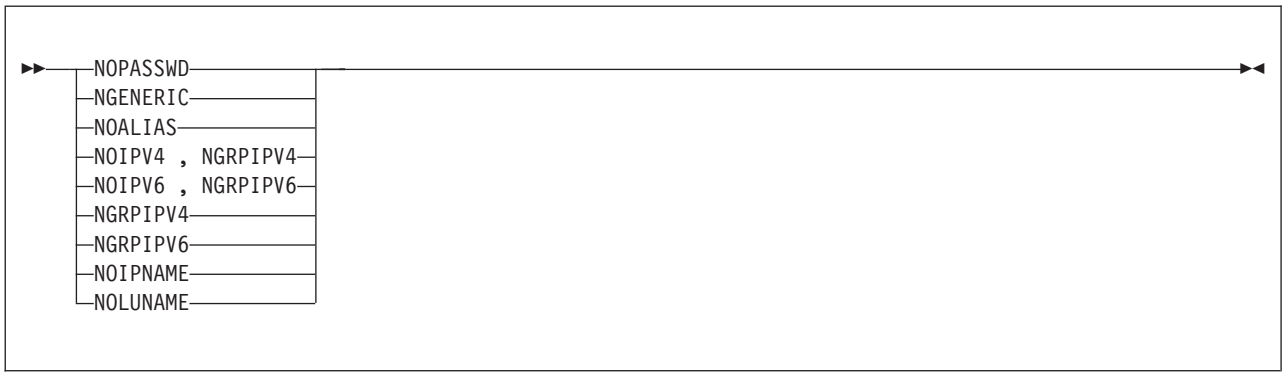
lu-spec:



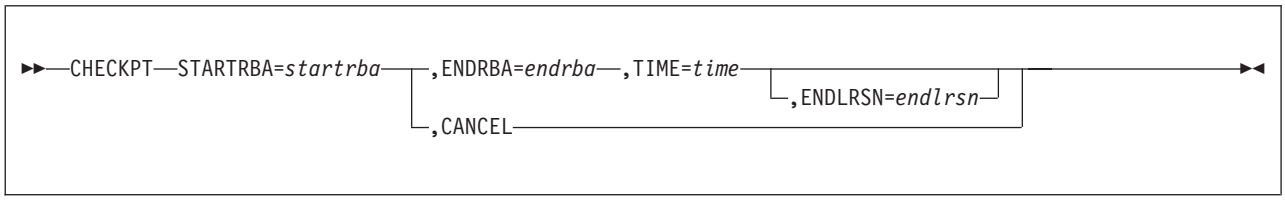
Notes:

1 You can specify each option (such as LOCATION or PORT) only once.

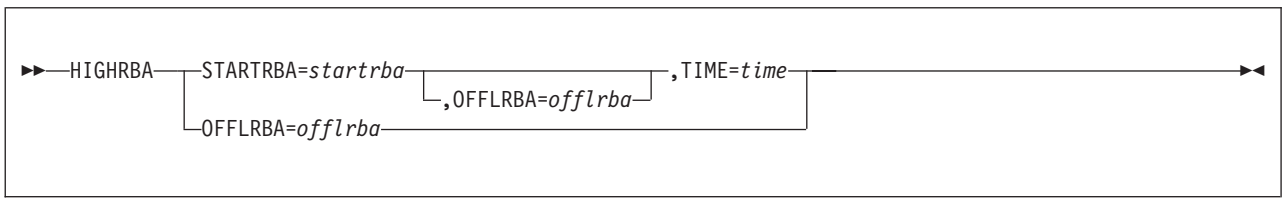
no-spec:



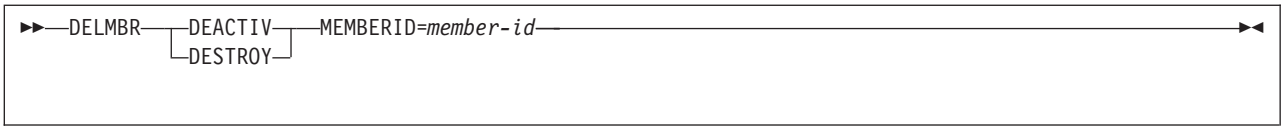
CHECKPT statement



HIGHRBA statement



DELMBR statement



RSTMBR statement

Option descriptions

NEWLOG

Declares one of the following data sets:

- A VSAM data set that is available for use as an active log data set.

  Use only the keywords DSNAME=, COPY1, and COPY2.
- An active log data set that is replacing one that encountered an I/O error.

  Use only the keywords DSNAME=, COPY1, COPY2, STARTRBA=, and ENDRBA=.
- An archive log data set volume.

  Use only the keywords DSNAME=,COPY1VOL=, COPY2VOL=, STARTRBA=, ENDRBA=, UNIT=, CATALOG=, STRTLRSN=, and ENDLRSN=.

  If you create an archive log data set and add it to the BSDS with this utility, you can specify a name that DB2 might also generate. DB2 generates archive log data set names of the form DSNCAT.ARCHLOG*x*.A*nnnnnnn* where:

  – DSNCAT and ARCHLOG are parts of the data set prefix that you specified on installation panels DSNTIPA2 and DSNTIPH.

  – *x* is 1 for the first copy of the logs, and 2 is for the second copy.

  – A*nnnnnnn* represents the series of low-level qualifiers that DB2 generates for archive log data set names, beginning with A0000001, and incrementing to A0000002, A0000003, and so forth.

  For data sharing, the naming convention is DSNCAT.ARCHLOG1 or DSNCAT.DSN1.ARCLG1.

  If you do specify a name by using the same naming convention as DB2, you receive a dynamic allocation error when DB2 generates that name. The error message, DSNJ103I, is issued once. DB2 then increments the low-level qualifier to generate the next data set name in the series and offloads to it the next time DB2 archives. (The active log that previously was not offloaded is offloaded to this data set.)

  The newly defined active logs cannot specify a start and end LRSN. When DB2 starts, it reads the new active log data sets with an RBA range to determine the LRSN range, and updates the start and end LRSN in the BSDS for the new log data sets. The start and end LRSN for new active logs that contain active log data are read at DB2 start-up time from the new active log data sets that are specified in the change log inventory NEWLOG statements. For new archive logs that are defined with change log inventory, the user must specify the start and end RBAs. For data sharing, the user must also specify the start and end LRSNs. DB2 startup does not attempt to find these values from the new archive log data sets.

DSNAME= *data-set-name*
Specifies a log data set.

data-set-name can be up to 44 characters long.

COPY1
Makes the data set an active log copy-1 data set.

COPY2
Makes the data set an active log copy-2 data set.

STARTRBA= *startrba*

Identifies a hexadecimal number of up to 20 characters. If you use fewer than 20 characters, leading zeros are added. *startrba* must end with '000'; otherwise DB2 returns a DSNJ4381 error message. You can obtain the RBA from messages or by printing the log map.

On the NEWLOG statement, *startrba* gives the log RBA of the beginning of the replacement active log data set or the archive log data set volume that is specified by DSNAME.

On the CRESTART statement, *startrba* is the earliest RBA of the log that is to be used during restart. If you omit STARTRBA, DB2 determines the beginning of the log range.

On the CHECKPT statement, *startrba* indicates the start checkpoint log record.

STARTRBA is required when STARTIME is specified.

On the HIGHRBA statement, *startrba* denotes the log RBA of the highest-written log record in the active log data sets.

ENDRBA= *endrba*

endrba is a hexadecimal number of up to 20 characters. If you use fewer than 20 characters, leading zeros are added. *endrba* must end with '000' or DB2 returns a DSNJ4381 error message.

On the NEWLOG statement, *endrba* gives the log RBA (relative byte address within the log) of the end of the replacement active log data set or the archive log data set volume that is specified by DSNAME.

On the CRESTART statement, *endrba* is the last RBA of the log that is to be used during restart, and it is also the starting RBA of the next active log that is written after restart. Any log information in the bootstrap data set, the active logs, and the archive logs with an RBA that is greater than *endrba* is discarded. If you omit ENDRBA, DB2 determines the end of the log range.

The value of ENDRBA must be a multiple of 4096. (The hexadecimal value must end in 000.) Also, the value must be greater than or equal to the value of STARTRBA. If STARTRBA and ENDRBA are equal, the next restart is a cold start; that is, no log records are processed during restart. The specified RBA becomes the beginning RBA of the new log.

On the CHECKPT statement, *endrba* indicates the end checkpoint log record that corresponds to the start checkpoint log record.

COPY1VOL= *vol-id*
vol-id is the volume serial of the copy-1 archive log data set that is specified after DSNAME.

COPY2VOL=*vol-id*
vol-id is the volume serial of the copy-2 archive log data set that is specified after DSNAME.

UNIT=*unit-id*
unit-id is the device type of the archive log data set that is named after DSNAME.

CATALOG
Indicates whether the archive log data set is to be cataloged.

NO Indicates that the archive log data set is not to be cataloged. All subsequent allocations of the data set are made using the unit and volume information that is specified on the statement.

YES
Indicates that the archive log data set is to be cataloged. All subsequent allocations of the data set are made using the catalog.

DB2 requires that all archive log data sets on disk be cataloged. Select CATALOG=YES if the archive log data set is on disk.

STRTLRSN= *startlrsn*
On the NEWLOG statement, *startlrsn* identifies the LRSN in the log record header of the first complete log record on the new archive data set. *startlrsn* is a hexadecimal number of up to 20 characters. If you use fewer than 20 characters, leading zeros are added. In a data sharing environment, run the print log map utility to find an archive log data set and start and end RBAs and LRSNs.

ENDLRSN=*endlrsn*

endlrsn is a hexadecimal number of up to 20 characters. If you use fewer than 20 characters, leading zeros are added. In a data sharing environment, run the print log map utility to find an archive log data set and start and end RBAs and LRSNs.

For the NEWLOG and CHECKPT statements, the ENDLRSN option is valid only in a data sharing environment. For the CRESTART statement, the ENDLRSN option is valid in both data sharing and non-data sharing environments. This option cannot be specified with STARTRBA or ENDRBA.

On the NEWLOG statement, *endlrsn* is the LRSN in the log record header of the last log record on the new archive data set.

On the CRESTART statement, in a data sharing environment, *endlrsn* is an LRSN value that is to be used as the log truncation point. A valid log truncation point is any LRSN value for which there exists a log record with an LRSN that is greater than or equal to the specified LRSN value. Any log information in the bootstrap data set, the active logs, and the archive logs with an LRSN greater than *endlrsn* is discarded. If you omit ENDLRSN, DB2 determines the end of the log range.

In a non-data sharing environment, *endlrsn* is the RBA value that matches the start of the last log record that is to be used during restart. Any log information in the bootstrap data set, the active logs, and the archive logs with an RBA that is greater than *endlrsn* is discarded. If the *endlrsn* RBA value does not match the start of a log record, DB2 restart fails. If you omit ENDLRSN, DB2 determines the end of the log range.

On the CHECKPT statement, *endlrsn* is the LRSN of the end checkpoint log record.

STARTIME=*startime*
Enables you to record the start time of the RBA in the BSDS. This field is optional.

startime specifies the start time in the following timestamp format:

```
yyyydddhhmmsst
```

In this format:

yyyy Indicates the year (1989-2099).
ddd Indicates the day of the year (0-365; 366 in leap years).
hh Indicates the hour (0-23).
mm Indicates the minutes (0-59).
ss Indicates the seconds (0-59).
t Indicates tenths of a second.

If fewer than 14 digits are specified for the STARTIME or ENDTIME parameter, trailing zeros are added.

If STARTIME is specified, the ENDTIME, STARTRBA, and ENDRBA options must also be specified.

ENDTIME= *endtime*
Enables you to record the end time of the RBA in the BSDS. This field is optional.

endtime specifies the end time in the same timestamp format as the STARTIME option. The ENDTIME value must be greater than or equal to the value of STARTIME.

DELETE
Deletes either CCSID information or log data set information from the bootstrap data sets. To delete CCSID information, specify the CCSIDS option. To delete all information for a specified log data set or volume, specify the DSNAME option.

CCSIDS
Deletes CCSID information from the BSDS. CCSID information is stored in the BSDS to ensure that you do not accidentally change the CCSID values.

Use this option under the direction of IBM Software Support when the CCSID information in the BSDS is incorrect. After you run a DSNJU003 job with the DELETE CCSIDS option, the CCSID values from the application defaults load module are recorded in the BSDS the next time DB2 is started.

CRESTART
Controls the next restart of DB2, either by creating a new conditional restart control record or by canceling the one that is currently active.

CREATE
Creates a new conditional restart control record. When the new record is created, the previous control record becomes inactive.

SYSPITR=*log-truncation-point*
Specifies the log RBA (non-data sharing system) or the log LRSN (data sharing system) that represents the log truncation point for the point-in-time for system recovery. Before you run the RESTORE SYSTEM utility to recover system data, you must use the SYSPITR option of DSNJU003. This option enables you to create a conditional restart control record to truncate the logs for system point-in-time recovery. You can also specify a value of FFFFFFFFFFFF to cause a point-in-time recovery to occur without log truncation.

log-truncation-point specifies the log RBA, log LRSN, or log FFFFFFFFFFFF. In a non-data sharing environment, *log-truncation point* is the RBA value that matches the start of the last log record that is to be used during restart. If the RBA value does not match the start of a log record, DB2 restart fails. In a data

sharing environment, *log-truncation point* is an LRSN value that is a valid log truncation point. A valid log truncation point is any LRSN value for which there exists a log record with an LRSN that is greater than or equal to the specified LRSN value. Use the same LRSN value for all members of the data sharing group that require log truncation.

You cannot specify any other option with CREATE, SYSPITR.

ENDTIME= *log-truncation-timestamp*
Specifies an end time value that is to be used as the log truncation point. A valid truncation point is any system time-of-day clock timestamp for which there exists a log record with a timestamp that is greater than or equal to the specified timestamp value. Any log information in the bootstrap data set, the active logs, and the archive logs with a timestamp greater than the ENDTIME is discarded. If you do not specify ENDTIME, DB2 determines the end of the log range.

You cannot specify any other option with CREATE, ENDTIME.

SYSPITRT= *log-truncation-timestamp*
Specifies the timestamp value that represents the point-in-time log truncation point for system recovery. Before you run the RESTORE SYSTEM utility to recover system data, you must use the SYSPITR or SYSPITRT option of DSNJU003. The options enable you to create a conditional restart control record to truncate the logs for system point-in-time recovery.

Log-truncation-timestamp specifies a timestamp value that is to be used as the log truncation point. A valid log truncation point is any system time-of-day clock timestamp for which there exists a log record with a timestamp that is greater than or equal to the specified timestamp value. Any log information in the bootstrap data set, the active logs, and the archive logs with a timestamp greater than SYSPITRT is discarded. If you omit SYSPITRT, DB2 determined the end of the log range. Use the same timestamp value for all members of the data sharing group that require log truncation.

You cannot specify any other option with CREATE, SYSPITRT.

Note: The startime keyword specifies the start time in the yyyydddhhmmsst timestamp format. See the STARTIME option for details about the timestamp.

CANCEL
On the CRESTART statement, deactivates the currently active conditional restart control record. The record remains in the BSDS as historical information.

No other keyword can be used with CANCEL on the CRESTART statement.

On the CHECKPT statement, deletes the checkpoint queue entry that contains a starting RBA that matches the parameter that is specified by the STARTRBA keyword.

Attention: This statement can override DB2's efforts to maintain data in a consistent state. Do not use this statement without understanding the conditional restart process.

CHKPTRBA= *chkptrba*
Identifies the log RBA of the start of the checkpoint record that is to be used during restart.

If you use STARTRBA or ENDRBA, and you do not use CHKPTRBA, the DSNJU003 utility selects the RBA of an appropriate checkpoint record. If you do use CHKPTRBA, you override the value that is selected by the utility.

chkptrba must be in the range that is determined by *startrba* and *endrba* or their default values.

If possible, do not use CHKPTRBA; let the utility determine the RBA of the checkpoint record.

CHKPTRBA=0 overrides any selection by the utility; at restart, DB2 attempts to use the most recent checkpoint record.

FORWARD=

Indicates whether to use the forward-log-recovery phase of DB2 restart, which reads the log in a forward direction to recover any units of recovery that were in one of the following two states when DB2 was last stopped:

- Indoubt (the units of recovery had finished the first phase of commit, but had not started the second phase)
- In-commit (had started but had not finished the second phase of commit)

YES

Allows forward-log recovery.

If you specify a cold start (by using the same value for STARTRBA and ENDRBA), no recovery processing is performed.

NO Terminates forward-log recovery before log records are processed. When you specify, FORWARD=NO, DB2 does not go back in the log to the beginning of any indoubt or in-commit units of recovery to complete forward recovery for these units. Choose this option if a very old indoubt unit of recovery exists to avoid a lengthy restart. The in-commit and indoubt units of recovery are marked as bypassed and complete in the log. However, any database writes that are pending at the end of the log, including updates from other units of recovery, are still written out during the forward phase of restart. Any updates that must be rolled-back, such as for an inflight or in-abort unit of recovery, are done during the backout phase of restart.

BACKOUT=

Indicates whether to use the backward-log-recovery phase of DB2 restart, which rolls back any units of recovery that were in one of the following two states when DB2 was last stopped:

- Inflight (did not complete the first phase of commit)
- In-abort (had started but not finished an abort)

YES

Allows backward-log recovery.

If you specify a cold start (by using the same value for STARTRBA and ENDRBA), no recovery processing is performed.

NO Terminates backward-log recovery before log records are processed.

CSRONLY

Performs only the first and second phases of restart processing (log initialization and current-status rebuild). After these phases, the system status is displayed, and restart terminates. Some parts of the log initialization are not performed, including any updating of the log and display of STARTRBA and ENDRBA information.

When DB2 is restarted with this option in effect, the conditional restart control record is not deactivated. To prevent the control record from remaining active, use the DSNJU003 utility again with CRESTART CANCEL, or with CRESTART CREATE to create a new active control record.

NEWCAT
Changes the VSAM catalog name in the BSDS.

VSAMCAT= *catalog-name*
Changes the VSAM catalog name entry in the BSDS.

catalog-name can be up to eight characters long. The first character must be alphabetic, and the remaining characters can be alphanumeric.

DDF
Updates the LOCATION, LUNAME, and other DDF related information values in the BSDS. If you use this statement to insert new values into the BSDS, you must include at least the LOCATION in the DDF statement. To update an existing set of values, you need to include only those values that you want to change. The DDF record cannot be deleted from the BSDS after it has been added; it can only be modified.

LOCATION= *location-name*
Changes the LOCATION value in the BSDS.

location-name specifies the name of your local DB2 site.

PORT
Identifies the TCP/IP port number that is used by DDF to accept incoming connection requests. This value must be a decimal number between 0 and 65535, including 65535; zero indicates that DDF's TCP/IP support is to be deactivated.

If DB2 is part of a data sharing group, all the members of the DB2 data sharing group must have the same value for PORT.

RESPORT
Identifies the TCP/IP port number that is used by DDF to accept incoming DRDA two-phase commit resynchronization requests. This value must be a decimal number between 0 and 65535, including 65535; zero indicates that DDF's TCP/IP support is to be deactivated. If RESPORT is non-zero, RESPORT must not be the same as the value that is supplied on PORT.

For data sharing DB2 systems, RESPORT must be uniquely assigned to each DB2 member, so that no two DB2 members use the same TCP/IP port for two-phase commit resynchronization.

SECPORT
Identifies the TCP/IP port number that is used by DDF to accept inbound secure DRDA connection requests. This value must be a decimal number between 0 and 65535, including 65535; zero indicates that DDF's secure connection support for TCP/IP is deactivated.

ALIAS= *alias-name :alias-port :alias-secport*
Specifies one or more alias names for the location. An alias name is a name besides the location name that connect processing can accept. Specifying an alias name does not change the location identifier for a database object.

Important: ALIAS applies to DRDA connections only.

You can specify and modify as many as eight location aliases by using the DSNJU003 utility. To specify more than 8 aliases, use the MODIFY DDF command with the ALIAS option.

alias-name specifies from 1 to 16 characters for the location name. *alias-name* cannot be one of the valid DSNJU003 keywords.

:alias-port specifies a TCP/IP port number for the alias that can be used by DDF to accept distributed requests. This value must be a decimal number between 1 and 65535, including 65535. The value must be different from the values for the PORT, RESPORT, and SECPORT options and any value that was specified for *alias-port* or *alias-secport* of any other defined alias. Specify a value for *alias-port* when you want to identify a subset of data sharing members to which a distributed request can go.

:alias-secport specifies a secure TCP/IP port number for the alias that can be used by DDF to accept secure distributed requests using SSL. This value must be a decimal number between 1 and 65535, including 65535. The value must be different from the values for the SECPORT, PORT, and RESPORT options, and any value that was specified for *alias-port* or *alias-secport* of any other defined alias. Specify a value for *alias-secport* when you want to identify a subset of data sharing members to which a secure distributed request can go. When you specify a value for *alias-secport*, the *:alias-port* value is optional.

You can add or replace aliases by respecifying the ALIAS option. The new list of names replaces the existing list.

Related information:

-MODIFY DDF (DB2) (DB2 Commands)

IPNAME= *ipname*

Changed the IPNAME values in the BSDS.

ipname specifies the IPNAME value. The value can be up to 8-bytes in length and must be an alphanumeric character beginning with an alphabetic character. When you specify this option, the DDF will activate only its TCP/IP communications support, regardless of whether or not there is a value for LUNAME. Only inbound and outbound DRDA protocol communications over TCP/IP is allowed and there is no attempt to activate SNA/APPC communications support.

The value specified must be either unique to this DB2 subsystem with an enterprise, or if the DB2 subsystem is configured to be a member of a data sharing group, unique to the data sharing group for which this DB2 subsystem is a member. All members of a data sharing group must be defined with the same IPNAME value if all the members are to activate only their TCP/IP communications support. If some members of a data sharing group activate their SNA/APPC (as well as TCP/IP communications support), then the IPNAME value chosen for the TCP/IP only members must match the GENERIC value specified for the members which activate their SNA/APPC as well as their TCP/IP communications support.

The value given to IPNAME will be used by DB2 as the network-id portion of a unit-of-work identifier. A unit-of-work identifier has traditionally been made up of a network-id, a LU name, a 6-byte unique identifier created from a timestamp, and a 2-byte current commit count value. When running with an IPNAME value, the LU name portion of the unit-of-work identifier will be created from a 4-byte character representation of the hexadecimal notation of the value specified for the TCP/IP resync port (RESPORT). This support for activating only TCP/IP communications will occur only if the DB2 is running in V9 New Function Mode.

Do not confuse IPNAME with a TCP/IP external such as hostname or domain name. The value you give IPNAME is only used internally by DB2 or in a DRDA exchange with another DRDA server. It cannot be referenced by any TCP/IP external, such as ping. Also, the hostname of the system upon which

the DB2 is running is a poor choice for IPNAME because more than one DB2 could run on the same system, and the IPNAME value given to any DB2 or DB2 data sharing group must be unique within an enterprise.

IPV4= *ipv4-address*
Identifies and associates a constant IPv4 IP address with DDF to accept incoming connection requests to this specific subsystem only. This address must be entered in dotted decimal form. If an IP address is not specified, DB2 will automatically determine the IP address from TCP/IP.

When DB2 is a member of a data sharing group, it is strongly recommended that you refer to a dynamic virtual IP address (DVIP). A group IP address, GRPIPV4, should also be specified.

IPV6= *ipv6-address*
Identifies and associates a constant IPv6 IP address with DDF to accept incoming connection requests to this specific subsystem only. This address must be entered in colon hexadecimal form. If an IP address is not specified, DB2 will automatically determine the IP address from TCP/IP.

When DB2 is a member of a data sharing group, it is strongly recommended that you refer to a dynamic virtual IP address (DVIP). A group IP address, GRPIPV6, should also be specified.

GRPIPV4
Identifies and associates a constant IPv4 IP address with the data sharing group for which this DDF is a member. The IP address is used to accept incoming connection requests that can be serviced by any member of the data sharing group. This address must be entered in dotted decimal form. An associated IPv4 subsystem/member address must also be specified in order to identify the IP address associated with this specific member of the group. If an IP address is not specified, DB2 will automatically determine the IP address from TCP/IP.

It is strongly recommended that you refer to a sysplex distributor owned distributing dynamic virtual IP address (DVIPA).

GRPIPV6
Identifies and associates a constant IPv6 IP address with the data sharing group for which this DDF is a member. The IP address is used to accept incoming connection requests that can be serviced by any member of the data sharing group. This address must be entered in colon hexadecimal form. An associated IPv6 subsystem/member address must also be specified in order to identify the IP address associated to this specific member of the group. If an IP address is not specified, DB2 will automatically determine the IP address from TCP/IP.

It is strongly recommended that you refer to a sysplex distributor owned distributing dynamic virtual IP address (DVIPA).

LUNAME= *luname*
Changes the LUNAME value in the BSDS.

luname specifies the LUNAME value. The LUNAME in the BSDS must always contain the value that identifies your local DB2 subsystem to the VTAM® network.

PASSWORD=
The DDF password follows VTAM convention, but DB2 restricts it to one to eight alphanumeric characters. The first character must be either a capital letter

or an alphabetic extender. The remaining characters can consist of alphanumeric characters and alphabetic extenders.

password
Optionally assigns a password to the distributed data facility communication record that establishes communications for a distributed data environment. The PRTCT=*password* option on the APPL definition statement is used to define DB2 to VTAM.

GENERIC= *gluname*
Replaces the value of the DB2 GENERIC LUNAME subsystem parameter in the BSDS.

gluname specifies the GENERIC LUNAME value.

NOPASSWD
Removes the archive password protection for all archives that are created after this operation. It also removes a previously existing password from the DDF record. No other keyword can be used with NOPASSWD.

NGENERIC
Changes the DB2 GENERIC LUNAME to binary zeros in the BSDS, indicating that no VTAM generic LU name support is requested.

NOALIAS
Indicates that no alias names exist for the specified location. Any alias names that were specified in a previous DSNJU003 utility job are removed.

NOIPV4
Removes the constant IPv4 address from the BSDS. The NGRPIPV4 keyword must also be specified to ensure that the associated group address, if any, is also removed.

NOIPV6
Removes the constant IPv6 address from the BSDS. The NGRPIPV6 keyword must also be specified to ensure that the associated group address, if any, is also removed.

NGRPIPV4
Removes the constant data sharing group IPv4 address from the BSDS.

NGRPIPV6
Removes the constant data sharing group IPv6 address from the BSDS.

NOIPNAME
Removes the IPNAME value from the DDF record. No other keyword can be used with NOIPNAME.

NOLUNAME
Removes the LUNAME value from the DDF record. No other keyword can be used with NOLUNAME.

CHECKPT
Allows updating of the checkpoint queue with the start checkpoint and end checkpoint log records.

Attention: This statement can override DB2's efforts to maintain data in a consistent state. Do not use the statement without understanding the conditional restart and checkpoint processing processes.

TIME= *time*
On the CHECKPT statement, specifies the time that the start checkpoint record was written.

On the HIGHRBA statement, TIME specifies when the log record with the highest RBA was written to the log.

time specifies the time value. For timestamp format, see the STARTIME option description.

HIGHRBA
Updates the highest-written log RBA in either the active or archive log data sets.

Attention: This statement can override DB2's efforts to maintain data in a consistent state. Do not use the statement without understanding the conditional restart process.

OFFLRBA= *offlrba*
Specifies the highest-offloaded RBA in the archive log.

offlrba is a hexadecimal number of up to 20 characters. If you use fewer than 20 characters, leading zeros are added. The value must end with hexadecimal X'FFF'.

DELMBR
Deactivates or destroys a member of a data sharing group.

DEACTIV
Marks a member of a data sharing group for deactivation. Deactivation is the first step in deletion of a member from a data sharing group.

Before the member can be deactivated, it must be quiesced and have no outstanding work. The logs and BSDS must exist.

DESTROY
Completes the deletion of a member from a data sharing group.

After a member is destroyed, its member ID can be reused, and the logs and BSDS can be deleted.

RSTMBR
Restores a deactivated member of a data sharing group to the quiesced state.

MEMBERID= *member-id*
Specifies the data sharing group member that is to be deactivated, destroyed, or restored.

member-id is a number in the range 1 - 32. This number is the member ID that shown in the output from the DISPLAY GROUP command or the DSNJU004 (print log map) utility.

Related information:

"DSNJU004 (print log map) output" on page 926

DSN7100I (DB2 Messages)

Related concepts:

Member-specific access (DB2 Data Sharing Planning and Administration)

Phase 3: Forward log recovery (DB2 Administration Guide)

Timestamp (DB2 SQL)

Related tasks:

Deleting data sharing members (DB2 Data Sharing Planning and Administration)

Performing conditional restart (DB2 Administration Guide)

Restoring deactivated data sharing members (DB2 Data Sharing Planning and Administration)

Related information:

PRTCT (SNA Resource Definition Reference)

Making changes for active logs

You can add, delete, record, and enlarge active logs.

Adding: If an active log is in stopped status, it is not reused for output logging; however, it continues to be used for reading. To add a new active log:

1. Use the Access Method Services DEFINE command to define new active log data sets.
2. Use DSNJLOGF to preformat the new active log data sets.

   If you do not preformat these logs with the DSNJLOGF utility, DB2 needs to preformat them the first time that they are used, and performance might be impacted. Empty data sets and data sets with residual data need to be preformatted.
3. Use DSNJU003 to register the new data sets in the BSDS.

For example, specify the following statements:

```
NEWLOG DSNAME=DSNC110.LOGCOPY1.DS04,COPY1
NEWLOG DSNAME=DSNC110.LOGCOPY2.DS04,COPY2
```

To copy the contents of an old active log data set to the new one, you can also give the RBA range and the starting and ending timestamp on the NEWLOG statement.

To archive to disk when the size of your active logs has increased, you might find it necessary to increase the size of your archive data set primary and secondary space quantities in DSNZPARM.

Deleting: To delete information about an active log data set from the BSDS, you might specify the following statements:

```
DELETE DSNAME=DSNC110.LOGCOPY1.DS01
DELETE DSNAME=DSNC110.LOGCOPY2.DS01
```

Recording: To record information about an existing active log data set in the BSDS, you might specify the following statement:

```
NEWLOG DSNAME=DSNC110.LOGCOPY2.DS05,COPY2,STARTIME=19910212205198,
             ENDTIME=19910412205200,STARTRBA=43F8000,ENDRBA=65F3FFF
```

You can insert a record of that information into the BSDS for any of these reasons:

- The data set has been deleted and is needed again.
- You are copying the contents of one active log data set to another data set (copy 1 to copy 2).
- You are recovering the BSDS from a backup copy.

Enlarging: When DB2 is inactive (down), use one of the following procedures.

If you can use the Access Method Services REPRO command, follow these steps:

1. Stop DB2. This step is required because DB2 allocates all active log data sets when it is active.
2. Use the Access Method Services ALTER command with the NEWNAME option to rename your active log data sets.
3. Use the Access Method Services DEFINE command to define larger active log data sets. Refer to installation job DSNTIJIN to see the definitions that create the original active log data sets.

   By reusing the old data set names, you don't need to run the change log inventory utility to establish new names in the BSDSs. The old data set names and the correct RBA ranges are already in the BSDSs.
4. Use the Access Method Services REPRO command to copy the old (renamed) data sets into their respective new data sets.
5. Start DB2.

If you cannot use the Access Method Services REPRO command, follow this procedure:

1. Ensure that all active log data sets except the current active log data sets have been archived. Active log data sets that have been archived are marked REUSABLE in print log map utility (DSNJU004) output.
2. Stop DB2.
3. Rename or delete the reusable active logs. Allocate new, larger active log data sets with the same names as the old active log data sets.
4. Run the DSNJLOGF utility to preformat the new log data sets.
5. Run the change log inventory utility (DSNJU003) with the DELETE statement to delete all active logs except the current active logs from the BSDS.
6. Run the change log inventory utility with the NEWLOG statement to add to the BSDS the active logs that you just deleted. So that the logs are added as empty, do not specify an RBA range.
7. Start DB2.
8. Issue the ARCHIVE LOG command to cause DB2 to truncate the current active logs and switch to one of the new sets of active logs.
9. Repeat steps 2 through 7 to enlarge the active logs that were just archived.

Although all log data sets do not need to be the same size, from an operational standpoint using the same size is more consistent and efficient. If the log data sets are not the same size, tracking your system's logs can be more difficult. Space can be wasted if you are using dual data sets of different sizes because they fill only to the size of the smallest, not using the remaining space on the larger one.

If you are archiving to disk and the size of your active logs has increased, you might need to increase the size of your archive log data sets. However, because of DFSMS disk management limits, you must specify less than 64 000 tracks for the primary space quantity. See the PRIMARY QUANTITY and SECONDARY QTY fields on installation panel DSNTIPA to modify the primary and secondary allocation space quantities.

Making changes for archive logs

You can add and delete archive logs.

Adding: When the recovery of an object depends on reading an existing archive log data set, the BSDS must contain information about that data set, so that the recovery job can find it. To register information about an existing archive log data set in the BSDS, you might specify the following statement:

```
NEWLOG DSNAME=DSNC110.ARCHLOG1.D89021.T2205197.A0000015,COPY1VOL=DSNV04,
UNIT=TAPE,STARTRBA=3A190000,ENDRBA=3A1F0FFF,CATALOG=NO
```

Deleting: To delete an entire archive log data set from one or more volumes, you might specify the following statement:

```
DELETE DSNAME=DSNC110.ARCHLOG1.D89021.T2205197.A0000015,COPY1VOL=DSNV04
```

A conditional restart control record

You can create a conditional restart control record in the BSDS.

To create a new conditional restart control record in the BSDS, you must execute the change log inventory utility and use the CRESTART control statement. For example, to truncate the log, to specify the earliest log RBA, and to bypass backout, use a statement similar to the following statement:

```
CRESTART CREATE,STARTRBA=28000,ENDRBA=58000,BACKOUT=NO
```

To specify a cold start, make the values of STARTRBA and ENDRBA equal with a statement similar to the following statement:

```
CRESTART CREATE,STARTRBA=4A000,ENDRBA=4A000
```

In most cases when doing a cold start, you should make sure that the STARTRBA and ENDRBA are set to an RBA value that is greater than the highest used RBA.

To truncate the DB2 logs via conditional restart by specifying a timestamp rather than an RBA value, use a statement similar to the following statement:

```
CRESTART CREATE,ENDTIME=20051402030068
```

An existing conditional restart control record governs any START DB2 operation until one of these events occurs:

- A restart operation completes.
- A CRESTART CANCEL statement is issued.
- A new conditional restart control record is created.

Deleting log data sets with errors

If an active log data set encounters an I/O error, use the DSNJU003 (change log inventory) utility to delete the log data sets with errors.

Procedure

To delete log data sets with errors:

1. If you use dual active log data sets, check if the data from the bad active log data set is saved in the other active log. If it is, you can use the other active log.
2. If you cannot use the other active log or if the active log is in the STOPPED status, fix the problem manually by taking the following steps

a. Check whether the data set was offloaded. For example, check the list of archive log data sets to see whether one has the same RBA range as the active log data set. This list can be created by using the DSNJU004 (print log map) utility.
b. If the data set was not offloaded, copy the data to a new VSAM data set. If the data set was offloaded, create a new VSAM data set that is to be used as an active log data set.
c. Run the change log inventory utility with the DELETE and NEWLOG statements.

   Important: If misused, the change log inventory utility can compromise the viability and integrity of the DB2 subsystem. Only highly skilled people, such as the DB2 system administrator, should use this utility, and then only after careful consideration.

   The DELETE statement removes information about the bad data set from the BSDS. The NEWLOG statement identifies the new data set as the new active log. The DELETE and NEWLOG operations can be performed by the same job step. The DELETE statement precedes the NEWLOG statement in the SYSIN input data set.

   To ensure consistent results, run the change log inventory utility on the same z/OS system on which the DB2 online subsystem runs.

   Use the print log map utility before and after you run the change log inventory utility to ensure correct execution and to document changes.

   When you use dual active logs, choose a naming convention that distinguishes primary and secondary active log data set. The naming convention should also identify the log data sets within the series of primary or secondary active log data sets. For example, the default naming convention that is established at DB2 installation time is as follows:

   ```
   prefix.LOGCOPYn.DSmm
   ```

   In this convention, *n*=1 for all primary log data sets, *n*=2 for all secondary log data sets, and *mm* is the data set number within each series.

   If a naming convention such as the default convention is used, pairs of data sets with equal *mm* values are usually used together. For example, DSNC120.LOGCOPY1.DS02 and DSNC120.LOGCOPY2.DS02 are used together.

   However, after you run the change log inventory utility with the DELETE and NEWLOG statements, the primary and secondary series can become unsynchronized. This situation can occur even if the NEWLOG data set name that you specify is the same as the old data set name. To avoid this situation, always do maintenance on both data sets of a pair in the same change log inventory execution:
   - Delete both data sets together.
   - Define both data sets together with NEWLOG statements.

   The data sets themselves do not require deletion and redefinition.

3. Delete the bad data set by using VSAM Access Method Services.

What to do next

Before you initiate a conditional restart or cold restart, consider making backup copies of all disk volumes that contain any DB2 data sets. These backup copies enable a possible fallback. The backup data sets must be generated when DB2 is not active.

Related reference:

Chapter 42, “DSNJU004 (print log map),” on page 923
“Syntax and options of the DSNJU003 control statement” on page 898

Altering references to log data sets in the BSDS

You can add or delete active or archive log data sets in the bootstrap data set (BSDS) by using the DSNJU003 utility.

About this task

Introductory concepts:

Bootstrap data set (Introduction to DB2 for z/OS)

When you alter references to log data sets in the BSDS, the log data sets are not changed. And you do not need to make any changes to the referenced log data sets.

Procedure

To alter references to log data sets in the BSDS:

- To add a reference to a data set in the BSDS, use the NEWLOG statement of the DSNJU003 utility.
- To delete a reference to a data set in the BSDS, use the DELETE statement of the DSNJU003 utility.

Related reference:

“Syntax and options of the DSNJU003 control statement” on page 898

Defining the high-level qualifier for catalog and directory objects

You can define the high-level qualifier for catalog and directory objects.

Procedure

Use the NEWCAT statement to define the high-level qualifier that is to be used for the following objects:

- Catalog table spaces and index spaces
- Directory table spaces and index spaces

At startup, the DB2 system checks that the name that is recorded with NEWCAT in the BSDS is the high-level qualifier of the DB2 system table spaces that are defined in the load module for subsystem parameters.
NEWCAT is normally used only at installation time.
When you change the high-level qualifier by using the NEWCAT statement, you might specify the following statements:

```
//S2 EXEC PGM=DSNJU003
//SYSUT1   DD DSN=DSNC120.BSDS01,DISP=OLD
//SYSUT2   DD DSN=DSNC120.BSDS02,DISP=OLD
//SYSPRINT DD SYSOUT=*
  NEWCAT VSAMCAT=DBP1
```

After you run the change log inventory utility with the NEWCAT statement, the utility generates output similar to the following output:

```
NEWCAT VSAMCAT=DBP1
DSNJ210I OLD VASAM CATALOG NAME=DSNC120, NEW CATALOG NAME=DBP1
DSNJ225I NEWCAT OPERATION COMPLETED SUCCESSFULLY
DSNJ200I DSNJU003 CHANGE LOG INVENTORY UTILITY
         PROCESSING COMPLETED SUCCESSFULLY
```

Related tasks:

"Renaming DB2 system data sets"

Renaming DB2 system data sets

Occasionally, you might want to rename the DB2 system table spaces

Procedure

To rename DB2 system data sets:

1. Stop DB2 in a consistent state.
2. Create a full system backup so that you can recover from operational errors.
3. Execute the change log inventory utility with NEWCAT.
4. Rename the BSDS and all DB2 directory and catalog table spaces and index spaces with IDCAMS.
5. Reassemble DSNZPARM to redefine the high-level qualifier for the system table spaces.
6. Update the BSDS name in the DB2 startup procedure.
7. Start DB2.
8. Drop and re-create the work file database.
9. Optionally use the ALTER command for table spaces in DSNDB04 and user databases.

Renaming DB2 active log data sets

When you rename system data sets, you might also want to rename the log data sets.

About this task

To rename DB2 active log data sets:

Procedure

1. Stop DB2 in a consistent state.
2. Create a full system backup so that you can recover from operational errors.
3. Delete the reusable active log data sets with IDCAMS, but keep the current active log.
4. Define a new set of active log data sets with IDCAMS.
5. Execute the change log inventory utility to remove names of deleted active log data sets and to define the new active log data set names in the BSDS.
6. Start and use DB2 normally.

Results

When the current active log is archived and becomes reusable, you can delete it.

Renaming DB2 archive log data sets

You do not need to rename archive log data sets because old archive logs are replaced as a part of the normal maintenance cycle and the RECOVER utility works with archive logs that contain different high-level qualifiers.

To modify the high-level qualifier for archive log data sets, you need to reassemble DSNZPARM.

Sample DSNJU003 control statements

Use the sample control statements as models for developing your own DSNJU003 control statements.

Example 1: Adding a new archive log data set

The following control statement specifies that the DSNJU003 utility is to add the data set DSNREPAL.A0001187 to the BSDS. The volume serial number for the data set is DSNV04, as indicated by the COPY1VOL option. The device type is SYSDA, and the data set is not to be cataloged. The RBA of the beginning of the archive log data set volume is 3A190000, and the end RBA is 3A1F0FFF.

```
//STEP5 EXEC PGM=DSNJU003,COND=EVEN
//SYSUT1   DD DSN=DSNCAT.BSDS01,DISP=SHR
//SYSUT2   DD DSN=DSNCAT.BSDS02,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
NEWLOG DSNAME=DSNREPAL.A0001187,COPY1VOL=DSNV04,UNIT=SYSDA,
STARTRBA=3A190000,ENDRBA=3A1F0FFF,CATALOG=NO
/*
```

Example 2: Deleting a data set

The following control statement specifies that DSNJU003 is to delete data set DSNREPAL.A0001187 from the BSDS. The volume serial number for the data set is DSNV04, as indicated by the COPY1VOL option.

```
DELETE DSNAME=DSNREPAL.A0001187,COPY1VOL=DSNV04
```

Example 3: Creating a new conditional restart control record

The following statement specifies that DSNJU003 is to create a new conditional restart control record, which controls the next restart of DB2. BACKOUT=NO indicates that DB2 is not to execute the backward-log-recovery phase when it restarts. The ENDRBA option indicates that 000000010000 is the last RBA of the log that is to be used during restart. Any log information in the bootstrap data set, the active logs, and the archive logs with an RBA that is greater than this RBA is discarded.

```
CRESTART CREATE,BACKOUT=NO,ENDRBA=000000010000
```

Example 4: Adding a communication record to the BSDS

The following control statement specifies that DSNJU003 is to add a new communication record to the BSDS. The location, LU name, and password values are all provided.

```
DDF LOCATION=USIBMSTODB22,LUNAME=STL#M08,PASSWORD=$STL@290
```

Example 5: Updating a communication record with a secure TCP/IP port number in the BSDS

The following control statement specifies that DSNJU003 is to update the communication record in the BSDS to specify a secure TCP/IP port.

```
DDF LOCATION=XYZ,SECPORT=448
```

Example 6: Adding a communication record with an alias to the BSDS

The following control statement specifies that DSNJU003 is to add a communication record to the BSDS. The location, alias, LU name, and password values are all provided.

```
DDF LOCATION=USIBMSTODB22,ALIAS=STL715A1,STL715A2,LUNAME=STL#M08,PASSWORD=$STL0290
```

Note: The alias is an SQL identifier and should follow the rules of SQL identifiers. The identifier can not include special characters when you are naming a location alias.

Example 7: Adding multiple aliases and alias ports to the BSDS

The following control statement specifies five alias names for the communication record in the BSDS (MYALIAS1, MYALIAS2, MYALIAS3, MYALIAS4, and MYALIAS5). Only MYALIAS2 and MYALIAS5 support subsets of a data sharing group. Any alias names that were specified in a previous DSNJU003 utility job are removed.

```
DDF ALIAS=MYALIAS1,MYALIAS2:8002,MYALIAS3,MYALIAS4,MYALIAS5:10001
```

Example 8: Specifying a point in time for system recovery

The following control statement specifies that DSNJU003 is to create a new conditional restart control record. The SYSPITR option specifies an end RBA value as the point in time for system recovery for a non-data sharing system. For a data sharing system, use an end LRSN value instead of an end RBA value. This point in time is used by the RESTORE SYSTEM utility.

```
//JOBLIB  DD  DSN=USER.TESTLIB,DISP=SHR
//        DD  DSN=DSN910.SDSNLOAD,DISP=SHR
//STEP01 EXEC PGM=DSNJU003
//SYSUT1 DD DSN=DSNC910.BSDS01,DISP=OLD
//SYSUT2 DD DSN=DSNC910.BSDS02,DISP=OLD
//SYSPRINT DD SYSOUT=*
//SYSIN  DD *
  CRESTART CREATE,SYSPITR=04891665D000
/*
```

To indicate that a SYSPITR restart is to be done without log truncation, specify a SYSPITR value of all 'FFs in the DSNJU003 job with the CRESTART parameter.

```
//STEP1 EXEC PGM=DSNJU003
//SYSUT1 DD DSN=DSNC910.BSDS01,DISP=OLD
//SYSUT2 DD DSN=DSNC910.BSDS02,DISP=OLD
//SYSPRINT DD SYSOUT=
//SYSIN DD
CRESTART CREATE,SYSPITR=FFFFFFFFFFFF
/*
```

During the subsequent restart, the user will be asked to confirm the conditional restart with the following:

```
DSNJ256I ) DSNJW6 CONDITIONAL RESTART RECORD INDICATES SYSPITR
     RESTART WITH NO LOG TRUNCATION
DSNJ11I )  CONDITIONAL RESTART RECORD 1 CREATED AT 7.214 7:56
     WAS FOUND. REPLY Y TO USE, N TO CANCEL
```

Example 9: Removing aliases from a communication record

The following control statement specifies that no alias names apply. Any alias names that were specified in a previous DSNJU003 utility job are removed.

```
DDF NOALIAS
```

Chapter 42. DSNJU004 (print log map)

The DSNJU004 (print log map) stand-alone utility generates a variety of information that can be useful in backup and recovery situations.

The print log map (DSNJU004) utility lists the following information:

- Log data set name, log RBA association, and log LRSN for both copy 1 and copy 2 of all active and archive log data sets
- Active log data sets that are available for new log data
- Status of all conditional restart control records in the bootstrap data set
- Contents of the queue of checkpoint records in the bootstrap data set
- The communication record of the BSDS, if one exists
- Contents of the quiesce history record
- System and utility timestamps
- Contents of the checkpoint queue
- Archive log command history
- BACKUP SYSTEM utility history
- System CCSID information
- System-level backup information
- Information about deactivated and destroyed data sharing members

In a data sharing environment, the DSNJU004 utility can list information from any or all BSDSs of a data sharing group.

Environment

The DSNJU004 program runs as a batch job.

This utility can be executed either when DB2 is running and when it is not running. However, to ensure consistent results from the utility job, the utility and the DB2 online subsystem must both be executing under the control of the same operating system.

Output

In all migration modes, formatted RBA and LRSN values are displayed in 10-byte format. The 10-byte formatted display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion.

For recovery purposes, the 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains

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non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

The user ID of the DSNJU004 job must have requisite RACF authorization.

Required and optional data sets

DSNJU004 recognizes DD statements with the following DD names:

SYSUT1
Specifies and allocates the bootstrap data set. This statement is required. It allocates the BSDS. If the BSDS must be shared with a concurrently executing DB2 online subsystem, use DISP=SHR on the DD statement.

SYSPRINT
Specifies a data set or print spool class for print output. This statement is required. The logical record length (LRECL) is 125.

SYSIN (optional)
Contains the control statement. If you do not specify the SYSIN DD statement, BSDS information is printed only from the BSDS data set that is identified by the SYSUT1 DD statement.

GROUP
Names a single BSDS. DB2 can use this BSDS to find the names of all BSDSs in the group. Ensure that the BSDS name that you specify is not the BSDS of a member that has been quiesced since before new members joined the group. This statement is required if the control statement specifies either of these options:
- MEMBER *
- MEMBER(member-name)

M*nn*BSDS
Names the BSDS data set of a group member whose information is to be listed. You must specify one such DD statement for each member. The statements are required if the control statement specifies MEMBER DDNAME. *nn* represents a two-digit number. You must use consecutive two-digit numbers from 01 to the total number of required members. If a break occurs in the sequence of numbers, any number after the break is ignored.

Running the DSNJU004 utility

Use the following EXEC statement to execute this utility:

```
//   EXEC   PGM=DSNJU004
```

Recommendations

- For dual BSDSs, execute the print log map utility twice, once for each BSDS, to compare their contents.
- To ensure consistent results for this utility, execute the utility job on the same z/OS system on which the DB2 online subsystem executes.
- Execute the print log map utility regularly, possibly daily, to keep a record of recovery log data set usage.
- Use the print log map utility to document changes that are made by the change log inventory utility.

Related concepts:

Management of the bootstrap data set (DB2 Administration Guide)

Conditional restart (DB2 Administration Guide)

Related tasks:

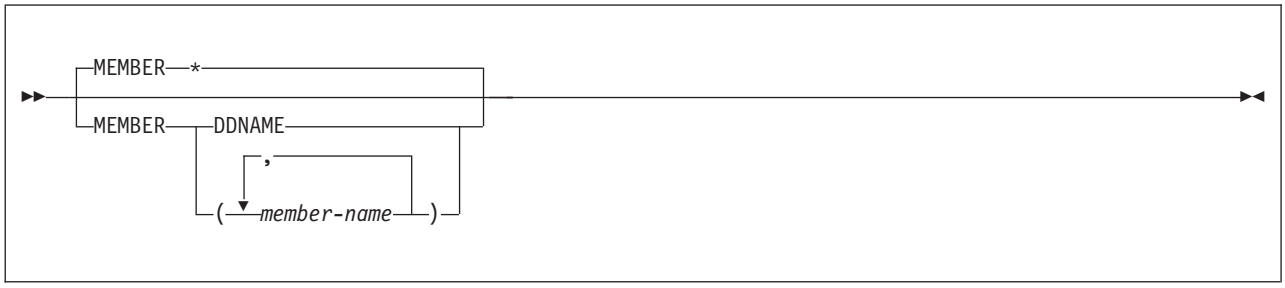
Deleting data sharing members (DB2 Data Sharing Planning and Administration)

Restoring deactivated data sharing members (DB2 Data Sharing Planning and Administration)

Syntax and options of the DSNJU004 control statement

Using the SYSIN data set allows you to list information from any or all BSDSs of a data sharing group.

DSNJU004 (print log map) syntax diagram



Option descriptions

The following keywords can be used in an optional control statement on the SYSIN data set:

MEMBER
Specifies which member's BSDS information to print.

***** Prints the information from the BSDS of each member in the data sharing group.

DDNAME
Prints information from only those BSDSs that are pointed to by the M*xx*BSDS DD statements.

(*member-name***)**
Prints information for only the named group members.

Sample DSNJU004 control statement

Use the sample control statements as models for developing your own DSNJU004 control statements.

The following statement specifies that DSNJU004 is to print information from the BSDS for each member in the data sharing group:

```
//PLM      EXEC PGM=DSNJU004
//GROUP    DD DSN=DBD1.BSDS01,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
           MEMBER *
```

DSNJU004 (print log map) output

The output of the DSNJU004 (print log map) utility is various backup and recovery information for a subsystem or data sharing members.

Specifically, DSNJU004 output includes the following information:

- The data set name (DSN) of the BSDS.
- The system date and time (SYSTEM TIMESTAMP), and the date and time that the BSDS was last changed by the change log inventory utility (UTILITY TIMESTAMP). For more information about these timestamp values in the output, see "Timestamps in the BSDS" on page 934.
- The integrated catalog facility (ICF) catalog name that is associated with the BSDS.
- The highest-written RBA. The value is updated each time the log buffers are physically written to disk.
- The highest RBA that was offloaded.
- Log RBA ranges (STARTRBA and ENDRBA) and data set information for active and archive log data sets. The last active log data set that is listed in the output is the current active log.
- Information about each active log data set. This information includes the starting and ending RBAs within the data set, the date and time the data set was created, and the data set name (DSN) and status. You might see consecutive active or archive log data sets with an end LRSN value that is the same as the beginning LRSN value of the next data set. For a description of the active log data set information in the output, see "Active log data set status" on page 935.
- Information about each archive log data set. This information includes the starting and ending RBAs within the data set, the date and time the data set was created, and the data set name (DSN), unit and volume of storage, and status. You might see consecutive active or archive log data sets with an end LRSN value that is the same as the beginning LRSN value of the next data set.
- Conditional restart control records. For a description of this output, see "Reading conditional restart control records" on page 937.
- The contents of the checkpoint description queue. For a description of this output, see Figure 116 on page 937.
- Archive log command history. For a description of this output, see "Archive log command history" on page 936.
- The distributed data facility (DDF) communication record. This record contains the location name as defined by DB2, any alias names for the location name, and the LU name as defined by VTAM. DB2 uses this information to establish the distributed database environment.
- The tokens for all BACKUP SYSTEM utility records. The token identifies each backup version that was created. For a description of this output, see "System-level backup information" on page 938.
- The RBA or LRSN when the subsystem was converted to enabling-new-function mode.
- Information about members of a data sharing group, including deactivated members and destroyed members whose slots were reclaimed.

The following figures show example output from the DSNJU004 (print log map) utility.

Example DSNJU004 output for a subsystem

The sample print log map utility output in the following figure is for a non-data-sharing subsystem.

```
|  ********************************************************************************
|  *                                                                              *
|  *   LOG MAP OF THE BSDS DATA SET BELONGING TO MEMBER 'NO NAME ' OF GROUP 'NO NAME '.  *
|  *                                                                              *
|  ********************************************************************************
|  DSNJCNVB CONVERSION PROGRAM HAS RUN   DDNAME=SYSUT1
|  DSNJCNVT CONVERSION PROGRAM HAS NOT RUN   DDNAME=SYSUT1
|     LOG MAP OF BSDS DATA SET COPY 1, DSN=DSNC000.DB2A.BSDS01
|     LTIME INDICATES LOCAL TIME, ALL OTHER TIMES ARE GMT.
|           DATA SHARING MODE IS OFF
|           SYSTEM TIMESTAMP   - DATE=2012.256  LTIME=13:50:24.23
|           UTILITY TIMESTAMP  - DATE=2012.256  LTIME=11:50:58.15
|           VSAM CATALOG NAME=DSNC000
|           HIGHEST RBA WRITTEN       0000000000007FA798CE  2012.256  20:50:57.4
|           HIGHEST RBA OFFLOADED     0000000000007FA6AFFF
|           RBA WHEN CONVERTED TO V4  00000000000069957FFF
|         THIS BSDS HAS MEMBER RECORDS FOR THE FOLLOWING MEMBERS:
|           HOST MEMBER NAME:
|             MEMBER ID:                 0
|             GROUP NAME:
|             BSDS COPY 1 DATA SET NAME:
|             BSDS COPY 2 DATA SET NAME:
|             ENFM START RBA/LRSN:       00000000000000000000
|                   **** DISTRIBUTED DATA FACILITY ****
|                          COMMUNICATION RECORD
|                        20:51:19 SEPTEMBER 12, 2012
|  LOCATION=STLEC1 IPNAME=(NULL) PORT=NULL SPORT=NULL RPORT=NULL
|  ALIAS=(NULL)
|  IPV4=NULL IPV6=NULL
|  GRPIPV4=NULL GRPIPV6=NULL
|  LUNAME=SYEC1DB2 PASSWORD=DB2PW1 GENERICLU=(NULL)
|  ACTIVE LOG COPY 1 DATA SETS
|   START RBA/TIME          END RBA/TIME            DATE/LTIME  DATA SET INFORMATION
|   ----------------------  ----------------------  ----------  --------------------
|   0000000000007FA6B000    0000000000007FA6FFFF    2011.110    DSN=DSNC000.DB2A.LOGCOPY1.DS02
|     2012.256  20:50:44.8    2012.256  20:50:49.3     9:17     PASSWORD=(NULL) STATUS=TRUNCATED, REUSABLE
|   0000000000007FA70000    0000000000007FA73FFF    2011.110    DSN=DSNC000.DB2A.LOGCOPY1.DS03
|     2012.256  20:50:49.3    2012.256  20:50:57.4     9:17     PASSWORD=(NULL) STATUS=TRUNCATED, REUSABLE
|   00000000000007FA74000    00000000000080E23FFF    2011.110    DSN=DSNC000.DB2A.LOGCOPY1.DS01
|     2012.256  20:50:57.4    ........  ..........     9:17     PASSWORD=(NULL) STATUS=REUSABLE
|  ARCHIVE LOG COPY 1 DATA SETS
|  NO ARCHIVE DATA SETS DEFINED FOR THIS COPY
|  ACTIVE LOG COPY 2 DATA SETS
|  NO ACTIVE DATA SETS DEFINED FOR THIS COPY
|  ARCHIVE LOG COPY 2 DATA SETS
|  NO ARCHIVE DATA SETS DEFINED FOR THIS COPY
|                  CONDITIONAL RESTART CONTROL RECORD
|                       20:51:19 SEPTEMBER 12, 2012
|   **** ACTIVE CRCR RECORD ****
|        NO CRCR RECORDS ARE ACTIVE
|   ****
|   CRCR IDENTIFIER  0002
|        USE COUNT   1
|        RECORD STATUS
|            CRCR NOT ACTIVE
|        PROCESSING STATUS
|            COLD START (STARTRBA = ENDRBA)
|            FORWARD =  NO
|            BACKOUT =  NO
|        STARTRBA                        000000000000000FE000
|        ENDRBA                          000000000000000FE000
|        ENDLRSN                         NOT SPECIFIED
|        ENDTIME                         NOT SPECIFIED
```

```
|        EARLIEST REQUESTED RBA          00000000000000000000
|        FIRST LOG RECORD RBA            00000000000000000000
|        ORIGINAL CHECKPOINT RBA         00000000000000000000
|        NEW CHECKPOINT RBA (CHKPTRBA)   NOT SPECIFIED
|        CRCR CREATED             19:51:36 SEPTEMBER 12, 2012
|        BEGIN RESTART            20:49:12 SEPTEMBER 12, 2012
|        RESTART PROGRESS                  STARTED     ENDED
|                                          =======     =====
|            CURRENT STATUS REBUILD           NO         NO
|            FORWARD RECOVERY PHASE           NO         NO
|            BACKOUT RECOVERY PHASE           NO         NO
|   CRCR IDENTIFIER  0001
|        USE COUNT   1
|        RECORD STATUS
|            CRCR NOT ACTIVE
|            SUCCESSFUL RESTART
|        PROCESSING STATUS
|            COLD START (STARTRBA = ENDRBA)
|            FORWARD =  NO
|            BACKOUT =  NO
|        STARTRBA                        00000000000069958000
|        ENDRBA                          00000000000069958000
|        ENDLRSN                         NOT SPECIFIED
|        ENDTIME                         NOT SPECIFIED
|        EARLIEST REQUESTED RBA          00000000000000000000
|        FIRST LOG RECORD RBA            00000000000000000000
|        ORIGINAL CHECKPOINT RBA         00000000000000000000
|        NEW CHECKPOINT RBA (CHKPTRBA)   NOT SPECIFIED
|        CRCR CREATED             16:17:06 APRIL 20, 2011
|        BEGIN RESTART            16:19:39 APRIL 20, 2011
|        END RESTART              16:19:48 APRIL 20, 2011
|        RESTART PROGRESS                  STARTED     ENDED
|                                          =======     =====
|            CURRENT STATUS REBUILD          YES        YES
|            FORWARD RECOVERY PHASE          YES        YES
|            BACKOUT RECOVERY PHASE          YES        YES
|                           CHECKPOINT QUEUE
|                       20:51:19 SEPTEMBER 12, 2012
|   ....
|        TIME OF CHECKPOINT       14:10:13 JUNE 22, 2012
|        BEGIN CHECKPOINT RBA             0000000000007AD2C562
|        END CHECKPOINT RBA               0000000000007AD2ECBE
|        END CHECKPOINT STCK              00C9C2079978DA000000
|        TIME OF CHECKPOINT       17:06:49 JUNE 13, 2012
|        BEGIN CHECKPOINT RBA             0000000000007AD1FE4B
|        END CHECKPOINT RBA               0000000000007AD2B2BE
|        END CHECKPOINT STCK              00C9B6DE530C48000000
|        SHUTDOWN CHECKPOINT
|        TIME OF CHECKPOINT       22:46:33 JUNE 12, 2012
|        BEGIN CHECKPOINT RBA             0000000000007ACFBB93
|        END CHECKPOINT RBA               0000000000007AD02A9E
|        END CHECKPOINT STCK              00C9B5E85C1961000000
|        TIME OF CHECKPOINT       22:46:29 JUNE 12, 2012
|        BEGIN CHECKPOINT RBA             0000000000007AC0F000
|        END CHECKPOINT RBA               0000000000007AC6D6B4
|        END CHECKPOINT STCK              00C9B5E8582489000000
|                        ARCHIVE LOG COMMAND HISTORY
|                         20:51:19 SEPTEMBER 12, 2012
|     DATE          TIME             RBA              MODE   WAIT   TIME
|  ------------  ----------  --------------------   -------  ----   -----
|  SEP 12, 2012  20:50:57.4  0000000000007FA73A2E   QUIESCE  YES      5 D
|  SEP 12, 2012  20:50:49.3  0000000000007FA6F35E
|  SEP 12, 2012  20:50:44.8  0000000000007FA6ACC2   QUIESCE   NO      5 D
|  SEP 12, 2012  20:50:39.9  0000000000007FA66543
|  DSNJ401I  DSNUPBHR BACKUP SYSTEM UTILITY HISTORY RECORD NOT FOUND
|                             SYSTEM CCSIDS
|                       20:51:19 SEPTEMBER 12, 2012
```

```
|      SYSTEM CCSIDS
|      --------------------
|      ASCII SBCS   = 1252
|      ASCII MIXED  = 65534
|      ASCII DBCS   = 65534
|      EBCDIC SBCS  = 37
|      EBCDIC MBCS  = 65534
|      EBCDIC DBCS  = 65534
|      UNICODE SBCS = 367
|      UNICODE MBCS = 1208
|      UNICODE DBCS = 1200
|  DSNJ200I  DSNJU004 PRINT LOG UTILITY PROCESSING COMPLETED SUCCESSFULLY
```

Figure 111. Sample print log map utility output for a non-data-sharing subsystem

Example DSNJU004 output for a data sharing member

The sample print log map utility output in the following figure is for a member of a data sharing group.

```
|   ********************************************************************************
|   *                                                                              *
|   *  LOG MAP OF THE BSDS DATA SET BELONGING TO MEMBER 'DL51    ' OF GROUP 'DSNL5   '.  *
|   *                                                                              *
|   ********************************************************************************
|   DSNJCNVT CONVERSION PROGRAM HAS RUN   DDNAME=GROUP
|      LOG MAP OF BSDS DATA SET COPY 1, DSN=DSNL5LOG.DL51.BSDS01
|      LTIME INDICATES LOCAL TIME, ALL OTHER TIMES ARE GMT.
|            DATA SHARING MODE IS ON
|            SYSTEM TIMESTAMP   - DATE=2013.164  LTIME=13:17:24.34
|            UTILITY TIMESTAMP  - DATE=2013.098  LTIME= 1:06:04.02
|            VSAM CATALOG NAME=DSNL5SYS
|            HIGHEST RBA WRITTEN       000000004C45C60F9E9E  2013.164  20:17:47.3
|            HIGHEST RBA OFFLOADED     000000004C45ACB5CFFF
|            RBA WHEN CONVERTED TO V4  00000000000000000000
|            MAX RBA FOR TORBA         00000000000000000000
|            MIN RBA FOR TORBA         00000000000000000000
|            STCK TO LRSN DELTA        00000000000000000000
|          THIS BSDS HAS MEMBER RECORDS FOR THE FOLLOWING MEMBERS:
|            HOST MEMBER NAME:            DL51
|              MEMBER ID:                 1
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL51.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL51.BSDS02
|              ENFM START RBA/LRSN:       00C72DC5B25477000000
|            MEMBER NAME:                 DL53
|              MEMBER ID:                 2
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL53.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL53.BSDS02
|            MEMBER NAME:                 DL52
|              MEMBER ID:                 3
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL52.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL52.BSDS02
|            MEMBER NAME:                 DL54
|              MEMBER ID:                 4
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL54.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL54.BSDS02
|            MEMBER NAME:                 DL55
|              MEMBER ID:                 5
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL55.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL55.BSDS02
|              THIS MEMBER WAS QUIESCED ON 2013.161 AT 14:23:22.9
```

```
|            MEMBER NAME:                 DL56
|              MEMBER ID:                 6
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME: DSNL5LOG.DL56.BSDS01
|              BSDS COPY 2 DATA SET NAME: DSNL5LOG.DL56.BSDS02
|              THIS MEMBER WAS QUIESCED ON 2013.133 AT 18:30:06.9
|            MEMBER NAME:                 DESTROYED
|              MEMBER ID:                 7
|              GROUP NAME:                DSNL5
|              BSDS COPY 1 DATA SET NAME:
|              BSDS COPY 2 DATA SET NAME:
|              THIS MEMBER WAS DESTROYED ON 2012.150 AT 17:54:09.5
|              THIS MEMBER ID IS AVAILABLE FOR REUSE
|                     **** DISTRIBUTED DATA FACILITY ****
|                          COMMUNICATION RECORD
|                       20:17:49 JUNE 13, 2013
|   LOCATION=DSNL5 IPNAME=(NULL) PORT=50200 SPORT=50290 RPORT=50201
|   ALIAS=DSNL5NETT01,DSNL5NETT02,DSNL5NETT03,
|         DSNL5NETT04,DSNL5NETT05
|   IPV4=9.30.178.71 IPV6=ABCD::91E:B247
|   GRPIPV4=9.30.178.50 GRPIPV6=ABCD::91E:B232
|   LUNAME=STBDL51 PASSWORD=(NULL) GENERICLU=STBDL5G
|   ACTIVE LOG COPY 1 DATA SETS
|    START RBA/LRSN/TIME     END RBA/LRSN/TIME       DATE/LTIME  DATA SET INFORMATION
|    ---------------------  ----------------------  ----------  --------------------
|    000000004C444BBDD000    000000004C44A455CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY1.DS03
|      00CB81C00D9C43400400    00CB81C3CE783A060000     9:41     STATUS=REUSABLE
|      2013.164  16:35:33.3    2013.164  16:52:20.9
|    000000004C44A455D000    000000004C44FC39CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY1.DS05
|      00CB81C3CE783A060000    00CB81C962BC23D21200     9:41     STATUS=TRUNCATED, REUSABLE
|      2013.164  16:52:20.9    2013.164  17:17:18.5
|    000000004C44FC39D000    000000004C45541DCFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY1.DS04
|      00CB81C962BC23D21200    00CB81CE3D7E49E72400    10:16     STATUS=REUSABLE
|      2013.164  17:17:18.5    2013.164  17:39:01.6
|    000000004C45541DD000    000000004C45ACB5CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY1.DS01
|      00CB81CE3D7E49E72400    00CB81D320A86B598000     9:41     STATUS=REUSABLE
|      2013.164  17:39:01.6    2013.164  18:00:53.6
|    000000004C45ACB5D000    000000004C46054DCFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY1.DS02
|      00CB81D320A86B598000    ....................     9:41     STATUS=NOTREUSABLE
|      2013.164  18:00:53.6    ........  ..........
|   ARCHIVE LOG COPY 1 DATA SETS
|    START RBA/LRSN/TIME     END RBA/LRSN/TIME       DATE/LTIME  DATA SET INFORMATION
|    ---------------------  ----------------------  ----------  --------------------
|    000000003ECDEE9AE000    000000003ECE4732DFFF    2013.074    DSN=DSNL5AR1.DL51.D13074.T0753360.A0165898
|      00CB108020450A8B8600    00CB10817DEBA05B8000     7:54     VOL=ARX081 UNIT=SYSDA
|      2013.074  14:47:52.2    2013.074  14:53:58.8
|                                                               CATALOGUED
|    000000003ECE4732E000    000000003ECE9FCADFFF    2013.074    DSN=DSNL5AR1.DL51.D13074.T0800383.A0165899
|      00CB10817DEBA05B8000    00CB10831082B6008800     8:01     VOL=ARX030 UNIT=SYSDA
|      2013.074  14:53:58.8    2013.074  15:01:01.0
|                                                               CATALOGUED
|  ...
|  000000004C44A455D000    000000004C44FC39CFFF    2013.164    DSN=DSNL5AR1.DL51.D13164.T1016560.A0176325
|      00CB81C3CE783A060000    00CB81C962BC23D21200    10:17     VOL=ARX054 UNIT=SYSDA
|      2013.164  16:52:20.9    2013.164  17:17:18.5
|                                                               CATALOGUED
|    000000004C44FC39D000    000000004C45541DCFFF    2013.164    DSN=DSNL5AR1.DL51.D13164.T1038388.A0176326
|      00CB81C962BC23D21200    00CB81CE3D7E49E72400    10:39     VOL=ARX755 UNIT=SYSDA
|      2013.164  17:17:18.5    2013.164  17:39:01.6
|                                                               CATALOGUED
|    000000004C45541DD000    000000004C45ACB5CFFF    2013.164    DSN=DSNL5AR1.DL51.D13164.T1100310.A0176327
|      00CB81CE3D7E49E72400    00CB81D320A86B598000    11:01     VOL=ARX224 UNIT=SYSDA
|      2013.164  17:39:01.6    2013.164  18:00:53.6
|                                                               CATALOGUED
|   ACTIVE LOG COPY 2 DATA SETS
|    START RBA/LRSN/TIME     END RBA/LRSN/TIME       DATE/LTIME  DATA SET INFORMATION
|    ---------------------  ----------------------  ----------  --------------------
```

```
|    000000004C444BBDD000    000000004C44A455CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY2.DS03
|      00CB81C00D9C43400400    00CB81C3CE783A060000     9:41     STATUS=REUSABLE
|      2013.164  16:35:33.3    2013.164  16:52:20.9
|    000000004C44A455D000    000000004C44FC39CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY2.DS05
|      00CB81C3CE783A060000    00CB81C962BC23D21200     9:41     STATUS=REUSABLE
|      2013.164  16:52:20.9    2013.164  17:17:18.5
|    000000004C44FC39D000    000000004C45541DCFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY2.DS04
|      00CB81C962BC23D21200    00CB81CE3D7E49E72400    10:16     STATUS=REUSABLE
|      2013.164  17:17:18.5    2013.164  17:39:01.6
|    000000004C45541DD000    000000004C45ACB5CFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY2.DS01
|      00CB81CE3D7E49E72400    00CB81D320A86B598000     9:41     STATUS=REUSABLE
|      2013.164  17:39:01.6    2013.164  18:00:53.6
|    000000004C45ACB5D000    000000004C46054DCFFF    2011.193    DSN=DSNL5LOG.DL51.LOGCOPY2.DS02
|      00CB81D320A86B598000    ....................     9:41     STATUS=NOTREUSABLE
|      2013.164  18:00:53.6    ........  ..........
|   ARCHIVE LOG COPY 2 DATA SETS
|   NO ARCHIVE DATA SETS DEFINED FOR THIS COPY
|                   CONDITIONAL RESTART CONTROL RECORD
|                        20:17:51 JUNE 13, 2013
|    **** ACTIVE CRCR RECORD ****
|         NO CRCR RECORDS ARE ACTIVE
|    ****
|    CRCR IDENTIFIER  0003
|         USE COUNT   1
|         RECORD STATUS
|             CRCR NOT ACTIVEf
|             SUCCESSFUL RESTART
|         PROCESSING STATUS
|             FORWARD = YES
|             BACKOUT =  NO
|         STARTRBA                         NOT SPECIFIED
|         ENDRBA                           NOT SPECIFIED
|         ENDLRSN                          NOT SPECIFIED
|         ENDTIME                          NOT SPECIFIED
|         EARLIEST REQUESTED RBA           00000000000000000000
|         FIRST LOG RECORD RBA             00000000000000000000
|         ORIGINAL CHECKPOINT RBA          00000000000000000000
|         NEW CHECKPOINT RBA (CHKPTRBA)    NOT SPECIFIED
|         CRCR CREATED              14:55:09 JANUARY 04, 2012
|         BEGIN RESTART             14:55:38 JANUARY 04, 2012
|         END RESTART               14:56:37 JANUARY 04, 2012
|         RESTART PROGRESS                   STARTED     ENDED
|                                            =======     =====
|             CURRENT STATUS REBUILD           YES        YES
|             FORWARD RECOVERY PHASE           YES        YES
|             BACKOUT RECOVERY PHASE           YES        YES
|    CRCR IDENTIFIER  0002
|         USE COUNT   1
|         RECORD STATUS
|             CRCR NOT ACTIVE
|             SUCCESSFUL RESTART
|         PROCESSING STATUS
|             COLD START (STARTRBA = ENDRBA)
|             FORWARD =  NO
|             BACKOUT =  NO
|         STARTRBA                         0000000011BE80000000
|         ENDRBA                           0000000011BE80000000
|         ENDLRSN                          NOT SPECIFIED
|         ENDTIME                          NOT SPECIFIED
|         EARLIEST REQUESTED RBA           00000000000000000000
|         FIRST LOG RECORD RBA             00000000000000000000
|         ORIGINAL CHECKPOINT RBA          00000000000000000000
|         NEW CHECKPOINT RBA (CHKPTRBA)    NOT SPECIFIED
|         CRCR CREATED              21:24:13 OCTOBER 16, 2011
|         BEGIN RESTART             21:51:25 OCTOBER 16, 2011
|         END RESTART               21:59:35 OCTOBER 16, 2011
|         RESTART PROGRESS                   STARTED     ENDED
```

```
|                                          =======     =====
|             CURRENT STATUS REBUILD         YES         YES
|             FORWARD RECOVERY PHASE         YES         YES
|             BACKOUT RECOVERY PHASE         YES         YES
|    CRCR IDENTIFIER  0001
|          USE COUNT   1
|          RECORD STATUS
|              CRCR NOT ACTIVE
|              SUCCESSFUL RESTART
|          PROCESSING STATUS
|              FORWARD =  NO
|              BACKOUT = YES
|          STARTRBA                          NOT SPECIFIED
|          ENDRBA                            NOT SPECIFIED
|          ENDLRSN                           NOT SPECIFIED
|          ENDTIME                           NOT SPECIFIED
|          EARLIEST REQUESTED RBA            00000000000000000000
|          FIRST LOG RECORD RBA              00000000000000000000
|          ORIGINAL CHECKPOINT RBA           00000000000000000000
|          NEW CHECKPOINT RBA (CHKPTRBA)   NOT SPECIFIED
|          CRCR CREATED              17:48:37 MARCH 23, 2010
|          BEGIN RESTART             17:49:57 MARCH 23, 2010
|          END RESTART               17:51:28 MARCH 23, 2010
|          RESTART PROGRESS                   STARTED     ENDED
|                                             =======     =====
|              CURRENT STATUS REBUILD           YES         YES
|              FORWARD RECOVERY PHASE           YES         YES
|              BACKOUT RECOVERY PHASE           YES         YES
|                             CHECKPOINT QUEUE
|                         20:17:51 JUNE 13, 2013
|          TIME OF CHECKPOINT        20:16:43 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C45C2CE07F2
|          END CHECKPOINT RBA                000000004C45C2D9AA15
|          END CHECKPOINT LRSN               00CB81F17D7369468E00
|          TIME OF CHECKPOINT        20:14:43 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C45BF6B54F0
|          END CHECKPOINT RBA                000000004C45BF781379
|          END CHECKPOINT LRSN               00CB81F10AEDE3280400
|          TIME OF CHECKPOINT        20:12:43 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C45B97FCACF
|          END CHECKPOINT RBA                000000004C45B98AFE56
|          END CHECKPOINT LRSN               00CB81F0984E2858AC00
|    ....
|          TIME OF CHECKPOINT        17:02:21 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C44CCDE6D2F
|          END CHECKPOINT RBA                000000004C44CCE8B409
|          END CHECKPOINT LRSN               00CB81C60AC5C633A600
|          TIME OF CHECKPOINT        17:00:21 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C44C50572CF
|          END CHECKPOINT RBA                000000004C44C50FB946
|          END CHECKPOINT LRSN               00CB81C598549EB09000
|          TIME OF CHECKPOINT        16:58:21 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C44BBDF62C0
|          END CHECKPOINT RBA                000000004C44BBE9CC54
|          END CHECKPOINT LRSN               00CB81C525E39E4CAE00
|          TIME OF CHECKPOINT        16:56:21 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C44B36E23A6
|          END CHECKPOINT RBA                000000004C44B3787B59
|          END CHECKPOINT LRSN               00CB81C4B372E7DD0400
|          TIME OF CHECKPOINT        16:54:21 JUNE 13, 2013
|          BEGIN CHECKPOINT RBA              000000004C44ACA3882B
|          END CHECKPOINT RBA                000000004C44ACB70485
|          END CHECKPOINT LRSN               00CB81C441338C1B2600
|                        ARCHIVE LOG COMMAND HISTORY
|                                MEMBER  DL51
|               DATA SHARING GROUP DSNL5    CONTAINS 7 MEMBERS
|                           20:17:51 JUNE 13, 2013
|    DATE/SDATE   TIME/STIME        RBA              MODE    WAIT  TIME   SCOPE  CMD ORIGIN   STATUS       ACTIVE
```

```
|   ------------  ----------  -------------------  -------  ----  -----  -----  ----------   ------       ------
|   JUN 10, 2013  13:25:41.9  000000004B744729CE22  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   JUN 03, 2013  15:12:07.0  000000004A22F3390BE4  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   MAY 20, 2013  15:54:03.1  00000000485391AC2858  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   MAY 13, 2013  16:20:31.7  0000000047B36F159850  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   MAY 06, 2013  13:25:22.9  000000004666B2D550FF  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   APR 29, 2013  16:26:52.2  000000004576BE7884CA  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   APR 22, 2013  14:12:22.4  0000000445250177700  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   APR 15, 2013  13:25:32.3  00000000435BF4740EC7  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   APR 08, 2013  13:25:58.9  00000000422B9CEA328A  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   APR 01, 2013  19:04:21.2  0000000040CD3F8A2AA1  QUIESCE   NO     5 D    G    DL51         PARTICIPANT     5
|   MAR 24, 2013  18:31:45.1  000000003F805C3E4A6C  QUIESCE   NO     5 D    G    DL51         PARTICIPANT     5
|   MAR 11, 2013  13:25:27.1  000000003DD42CA2D062  QUIESCE   NO     5 D    G    DL51         ORIGINATOR      5
|   DSNJ401I  DSNUPBHR BACKUP SYSTEM UTILITY HISTORY RECORD NOT FOUND
|                            SYSTEM CCSIDS
|                         20:17:51 JUNE 13, 2013
|       SYSTEM CCSIDS
|       --------------------
|       ASCII SBCS   = 1252
|       ASCII MIXED  = 65534
|       ASCII DBCS   = 65534
|       EBCDIC SBCS  = 37
|       EBCDIC MBCS  = 65534
|       EBCDIC DBCS  = 65534
|       UNICODE SBCS = 367
|       UNICODE MBCS = 1208
|       UNICODE DBCS = 1200
|   DSNJ200I  DSNJU004 PRINT LOG UTILITY PROCESSING COMPLETED SUCCESSFULLY
```

Figure 112. Sample print log map utility output for members of a data sharing group

Example DSNJU004 output for deactivated and destroyed members

The sample print log map utility output in the following figure is for a deactivated member and a destroyed member of a data sharing group.

```
| DSNJCNVB CONVERSION PROGRAM HAS RUN   DDNAME=SYSUT1
| DSNJCNVT CONVERSION PROGRAM HAS NOT RUN   DDNAME=SYSUT1
|    LOG MAP OF BSDS DATA SET COPY 1, DSN=DSNC000.DB2B.BSDS01
|    LTIME INDICATES LOCAL TIME, ALL OTHER TIMES ARE GMT.
|          DATA SHARING MODE IS ON
|          SYSTEM TIMESTAMP   - DATE=2012.256  LTIME=11:35:42.52
|          UTILITY TIMESTAMP  - DATE=2012.256  LTIME=10:40:27.07
|          VSAM CATALOG NAME=DSNC000
|          HIGHEST RBA WRITTEN       000000000000000682A  0000.000  00:00:00.0
|          HIGHEST RBA OFFLOADED     00000000000010000FFF
|          RBA WHEN CONVERTED TO V4  00000000000012F04FFF
|          MAX RBA FOR TORBA         00000000000012F04FFF
|          MIN RBA FOR TORBA         00000000000000000000
|          STCK TO LRSN DELTA        00000000000000000000
|        THIS BSDS HAS MEMBER RECORDS FOR THE FOLLOWING MEMBERS:
|          HOST MEMBER NAME:           DB2B
|            MEMBER ID:                2
|            GROUP NAME:               DSNCAT
|            BSDS COPY 1 DATA SET NAME: DSNC000.DB2B.BSDS01
|            BSDS COPY 2 DATA SET NAME: DSNC000.DB2B.BSDS02
|            ENFM START RBA/LRSN:      00000000000000000000
|          MEMBER NAME:                DB2A
|            MEMBER ID:                1
|            GROUP NAME:               DSNCAT
|            BSDS COPY 1 DATA SET NAME: DSNC000.DB2A.BSDS01
|            BSDS COPY 2 DATA SET NAME: DSNC000.DB2A.BSDS02
|          MEMBER NAME:                DESTROYED
|            MEMBER ID:                3
|            GROUP NAME:               DSNCAT
|            BSDS COPY 1 DATA SET NAME:
|            BSDS COPY 2 DATA SET NAME:
```

```
|             THIS MEMBER WAS DESTROYED ON 2012.109 AT 04:12:30.2
|             THIS MEMBER ID IS AVAILABLE FOR REUSE
|           MEMBER NAME:                 DB2D
|             MEMBER ID:                 4
|             GROUP NAME:                DSNCAT
|             BSDS COPY 1 DATA SET NAME: DSNC000.DB2D.BSDS01
|             BSDS COPY 2 DATA SET NAME: DSNC000.DB2D.BSDS02
|             THIS MEMBER WAS DEACTIVATED ON 2012.109 AT 01:46:52.4
```

Figure 113. Sample print log map utility output for deactivated and destroyed members of a data sharing group

Timestamps in the BSDS

The output of the DSNJU004 (print log map) utility includes many timestamps that are recorded in the BSDS. Those timestamps record the date and time of various system events.

Timestamps in the output column LTIME are in local time. All other timestamps are in Coordinated Universal Time (UTC).

Figure 111 on page 929 and Figure 112 on page 933 show example output from the print log map utility. The following timestamps are included in the header section of the reports:

System timestamp
Reflects the date and time that the BSDS was last updated. The BSDS can be updated by several events:

- DB2 startup.
- The write threshold is reached during log write activities.

  The BSDS might be updated several times a second, or it might not be updated for several seconds, minutes, or even hours. The frequency of updates depends on the number of output buffers that you specified and the system activity rate.
- An error situation where DB2 drops into single-BSDS mode from its normal dual BSDS mode. This action might occur when a request to get, insert, point to, update, or delete a BSDS record is unsuccessful. When this error occurs, DB2 updates the timestamp in the remaining BSDS to force a timestamp mismatch with the disabled BSDS.

Utility timestamp
The date and time that the contents of the BSDS were altered by the change log inventory (DSNJU003) utility.

The following timestamps are included in the active and archive log data sets portion of the reports:

Active log date
The date on which the active log data set was originally allocated on the DB2 subsystem.

Active log time
The time at which the active log data set was originally allocated on the DB2 subsystem.

Archive log date
The date of creation (not allocation) of the archive log data set.

Archive log time
The time of creation (not allocation) of the archive log data set.

The following timestamps are included in the conditional restart control record portion of the report that is shown in Figure 117 on page 938:

Conditional restart control record
The current time and date. This data is reported for information only and is not kept in the BSDS.

CRCR created
The time and date of creation of the CRCR by the CRESTART option in the change log inventory utility.

Begin restart
The time and date that the conditional restart was attempted.

End restart
The time and date that the conditional restart ended.

STARTRBA (timestamp)
The time at which the control interval was written.

ENDRBA (timestamp)
The time at which the last control interval was written.

Time of checkpoint
The time and date that are associated with the checkpoint record that was used during the conditional restart process.

The following timestamps are included in the checkpoint queue and the DDF communication record sections of the report that is shown in Figure 116 on page 937:

Checkpoint queue
The current time and date. This data is reported for information only and is not kept in the BSDS.

Time of checkpoint
The time and date that the checkpoint was taken.

DDF communication record (heading)
The current time and date. This data is reported for information only, and is not kept in the BSDS.

Active log data set status

The BSDS records the status of an active log data set as one of the status values that are listed in the following table.

Table 136. Statuses of active log data sets

Status	Meaning
NEW	The data set was defined but never used by DB2, or the log is truncated at a point before the data set was created. In either case, the data set starting and ending RBA values are reset to zero.
REUSABLE	Either the data set is new and has no records, or the data set was offloaded. In the print log map output, the start RBA value for the last REUSABLE data set is equal to the start RBA value of the last archive log data set.
NOT REUSABLE	The data set contains records that have not been offloaded.

Table 136. Statuses of active log data sets (continued)

Status	Meaning
STOPPED	The offload processor encountered an error while reading a record, and that record could not be obtained from the other copy of the active log. Alternatively, an error occurred during truncation of the data set following a write I/O error.
TRUNCATED	One of these conditions exists: • An I/O error occurred, and DB2 stopped writing to this data set. The active log data set is offloaded, beginning with the starting RBA and continuing to the last valid record segment in the truncated active log data set. (The RBA of the last valid record segment is less than the ending RBA of the active log data set.) Logging is switched to the next available active log data set and continues uninterrupted. • The log was truncated by a conditional restart at a point within the data set RBA range. • The DB2 ARCHIVE LOG command was issued while this data set was the current active log data set.

The status value for each active log data set is displayed in the print log map utility output, as shown in the following example output:

```
ACTIVE LOG COPY 1 DATA SETS
 START RBA/LRSN/TIME     END RBA/LRSN/TIME       DATE/LTIME  DATA SET INFORMATION
 ----------------------  ----------------------  ----------  --------------------
 00000000000026A05000    00000000000027DB4FFF    2011.122    DSN=DSNC000.DB2A.LOGCOPY1.DS02
   00C9FAE422D486000000    00C9FAE427BF40000000    16:49     STATUS=REUSABLE
   2012.219  19:35:03.9    2012.219  19:35:09.0
 00000000000027DB5000    00000000000028B65FFF    2011.122    DSN=DSNC000.DB2A.LOGCOPY1.DS03
   00C9FAE427BF40000000    00CA28653CDD94000000    16:49     STATUS=TRUNCATED, REUSABLE
   2012.219  19:35:09.0    0000.000  00:00:00.0
 00000000000028B66000    00000000000029F15FFF    2011.122    DSN=DSNC000.DB2A.LOGCOPY1.DS01
   00CA28653CDD94000000    ....................    16:49     STATUS=REUSABLE
   2012.256  00:12:15.8    ........  ..........
```

Figure 114. Portion of print log map utility output that shows active log data set status

Archive log command history

The print log map utility output also displays the archive log command history, as shown in the following figure.

```
                    ARCHIVE LOG COMMAND HISTORY
                     20:51:19 SEPTEMBER 12, 2012
   DATE          TIME            RBA              MODE   WAIT   TIME
------------  ----------  --------------------   -------  ----   -----
SEP 12, 2012  20:50:57.4  0000000000007FA73A2E   QUIESCE  YES      5 D
SEP 12, 2012  20:50:49.3  0000000000007FA6F35E
SEP 12, 2012  20:50:44.8  0000000000007FA6ACC2   QUIESCE   NO      5 D
SEP 12, 2012  20:50:39.9  0000000000007FA66543
```

Figure 115. Portion of print log map utility output that shows archive log command history

The values in the TIME column represent the time that the ARCHIVE LOG command was issued. This time value is saved in the BSDS and is converted to printable format at the time that the print log map utility is run. Therefore, this value, when printed, can differ from other time values that were recorded concurrently. Some time values are converted to printable format when they are recorded, and then they are saved in the BSDS. These printed values remain the same when the printed report is run.

Reading conditional restart control records

The print log map utility also lists information about each conditional restart control record and each checkpoint. A sample description of a checkpoint record in the queue is shown in the following figure.

```
                        CHECKPOINT QUEUE
                     19:31:37 SEPTEMBER 12, 2012
       TIME OF CHECKPOINT       19:31:26 SEPTEMBER 12, 2012
       BEGIN CHECKPOINT RBA             00000000000028C12842
       END CHECKPOINT RBA               00000000000028C16B7A
       END CHECKPOINT LRSN              00CA296855DA8EB58000
       TIME OF CHECKPOINT       19:31:20 SEPTEMBER 12, 2012
       BEGIN CHECKPOINT RBA             00000000000028C0C280
       END CHECKPOINT RBA               00000000000028C1057A
       END CHECKPOINT LRSN              00CA29684FE13EFAC000
       TIME OF CHECKPOINT       19:31:06 SEPTEMBER 12, 2012
       BEGIN CHECKPOINT RBA             00000000000028C059FE
       END CHECKPOINT RBA               00000000000028C09C7A
       END CHECKPOINT LRSN              00CA29684275C34C4000
       ...
       TIME OF CHECKPOINT       19:34:52 AUGUST 06, 2012
       BEGIN CHECKPOINT RBA             000000000000243F3D36
       END CHECKPOINT RBA               000000000000243F8C26
       END CHECKPOINT LRSN              00C9FAE41852F2000000
```

Figure 116. Sample print log map description of checkpoints

A sample description of a conditional restart control record is shown in the following figure.

```
| CRCR IDENTIFIER  0001
|       USE COUNT   0
|       RECORD STATUS
|           CRCR NOT ACTIVE
|           CRCR NOT USED
|       PROCESSING STATUS
|           FORWARD = YES
|           BACKOUT = YES
|       STARTRBA                        NOT SPECIFIED
|       ENDRBA                          NOT SPECIFIED
|       ENDLRSN                         NOT SPECIFIED
|       ENDTIME                         NOT SPECIFIED
|       EARLIEST REQUESTED RBA          00000000000000000000
|       FIRST LOG RECORD RBA            00000000000000000000
|       ORIGINAL CHECKPOINT RBA         00000000000000000000
|       NEW CHECKPOINT RBA (CHKPTRBA)   00000FF00000000FF000
|       CRCR CREATED             18:13:54 SEPTEMBER 12, 2012
|       RESTART PROGRESS                 STARTED     ENDED
|                                        =======     =====
|           CURRENT STATUS REBUILD          NO         NO
|           FORWARD RECOVERY PHASE          NO         NO
|           BACKOUT RECOVERY PHASE          NO         NO
|  CRCR IDENTIFIER  0002
|       USE COUNT   1
|       RECORD STATUS
|           CRCR NOT ACTIVE
|           SUCCESSFUL RESTART
|       PROCESSING STATUS
|           COLD START (STARTRBA = ENDRBA)
|           FORWARD =  NO
|           BACKOUT =  NO
|       STARTRBA                        00000000000012F05000
|       ENDRBA                          00000000000012F05000
|       ENDLRSN                         NOT SPECIFIED
|       ENDTIME                         NOT SPECIFIED
|       EARLIEST REQUESTED RBA          00000000000000000000
|       FIRST LOG RECORD RBA            00000000000000000000
|       ORIGINAL CHECKPOINT RBA         00000000000000000000
|       NEW CHECKPOINT RBA (CHKPTRBA)   NOT SPECIFIED
|       CRCR CREATED             23:49:14 MAY 02, 2011
|       BEGIN RESTART            23:51:43 MAY 02, 2011
|       END RESTART              23:52:04 MAY 02, 2011
|       RESTART PROGRESS                 STARTED     ENDED
|                                        =======     =====
|           CURRENT STATUS REBUILD          YES        YES
|           FORWARD RECOVERY PHASE          YES        YES
|           BACKOUT RECOVERY PHASE          YES        YES
```

Figure 117. Sample print log map description of a CRCR

System-level backup information

The print log map utility also displays information about system-level backup copies that are created by the BACKUP SYSTEM utility. An example of system-level backup information is shown in the following figure.

```
|                     BACKUP SYSTEM UTILITY HISTORY
|                           SUBSYSTEM ID DB2A
|                       00:05:08 SEPTEMBER 14, 2012
|             START STCK                                        DATA COMPLETE       DATA/LOG COMPLETE
|      DATA               LOG                 RBLP                  LRSN             DATE      LTIME
| ----------------  ----------------  --------------------  --------------------  --------------------
| CA2AC09F0F4456A0  0000000000000000  0000000000007FADA6AC  0000000000007FB42C2C  2012/09/13  14:11:46
|                  TOKEN = C4C2F2C1CA2AC09F0F4456A000007FADA6AC
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
| CA2AC09B25879868  0000000000000000  0000000000007FAB97E2  0000000000007FB0B9B4  2012/09/13  14:11:42
|                  TOKEN = C4C2F2C1CA2AC09B2587986800007FAB97E2
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
| CA2AC096C479E0E8  0000000000000000  0000000000007FA5C090  0000000000007FAD1A28  2012/09/13  14:11:39
|                  TOKEN = C4C2F2C1CA2AC096C479E0E800007FA5C090
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
```

Figure 118. System-level backup information

When a log copy pool is restored, accurate date and time values are not displayed for the system-level backup that is used to restore the copy pool. Instead, the DATA/LOG DATE value is displayed as 0000/00/00, and the COMPLETE LTIME value is displayed as 00:00:00. The reason is that this information is not recorded in the BSDS until after the system-level backup is complete. Therefore, this information is not available at the time that the backup copy of the BSDS is made.

The following figure shows an example of an incremental system-level backup. TYPE applies to only the database copy pool history entries.

```
|                     BACKUP SYSTEM UTILITY HISTORY
|                           SUBSYSTEM ID DB2A
|                       00:05:08 SEPTEMBER 14, 2012
|             START STCK                                        DATA COMPLETE
|      DATA               LOG                 RBLP                  LRSN
| ----------------  ----------------  --------------------  --------------------
| CA2AC09F0F4456A0  0000000000000000  0000000000007FADA6AC  0000000000007FB42C2C
|                  TOKEN = C4C2F2C1CA2AC09F0F4456A000007FADA6AC
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
| CA2AC09B25879868  0000000000000000  0000000000007FAB97E2  0000000000007FB0B9B4
|                  TOKEN = C4C2F2C1CA2AC09B2587986800007FAB97E2
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
| CA2AC096C479E0E8  0000000000000000  0000000000007FA5C090  0000000000007FAD1A28
|                  TOKEN = C4C2F2C1CA2AC096C479E0E800007FA5C090                   TYPE=I
|                  Z/OS 1.13  CAT=YES
|                  LOCATION NAME = STLEC1
```

Figure 119. System-level backup information as an incremental copy

Related concepts:

Management of the bootstrap data set (DB2 Administration Guide)

Conditional restart (DB2 Administration Guide)

Related tasks:

Deleting data sharing members (DB2 Data Sharing Planning and Administration)

Restoring deactivated data sharing members (DB2 Data Sharing Planning and Administration)

Related reference:

Chapter 9, “BACKUP SYSTEM,” on page 59

Chapter 43. DSN1COMP

The DSN1COMP stand-alone utility estimates space savings that are to be achieved by DB2 data compression in table spaces and indexes.

You can run this utility on the following types of data sets that contain uncompressed data:
- DB2 full image copy data sets
- VSAM data sets that contain DB2 table spaces
- Sequential data sets that contain DB2 table spaces (for example, DSN1COPY output)

Restrictions:

You cannot run DSN1COMP on concurrent copies.

DSN1COMP does not estimate savings for data sets that contain LOB table spaces.

If you run DSN1COMP on a table space in which the data is the same for all rows, message DSN1941I is issued. In this case, DSN1COMP does not compute any statistics.

Environment

Run DSN1COMP as a z/OS job.

You can run DSN1COMP even when the DB2 subsystem is not operational. Before you use DSN1COMP when the DB2 subsystem is operational, issue the DB2 STOP DATABASE command. Issuing the STOP DATABASE command ensures that DB2 has not allocated the DB2 data sets.

Do not run DSN1COMP on table spaces in DSNDB01, DSNDB06, or DSNDB07.

Authorization required

DSN1COMP does not require authorization. However, if any of the data sets is RACF-protected, the authorization ID of the job must have RACF authority.

Required data sets

DSN1COMP uses the following data definition (DD) statements:

SYSPRINT
Defines the data set that contains output messages from DSN1COMP and all hexadecimal dump output.

SYSUT1
Defines the input data set, which can be a sequential data set or a VSAM data set.

Specify the disposition for this data set as OLD (DISP=OLD) to ensure that it is not in use by DB2. Specify the disposition for this data set as SHR (DISP=SHR) only in circumstances where the DB2 STOP DATABASE command does not work.

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The requested operation takes place only for the specified data set. In the following situations, you must specify the correct data set.

- The input data set belongs to a nonpartitioned table space.
- The index space is larger than 2 GB.
- The table space or index space is a partitioned space.

If you are running the online REORG utility with FASTSWITCH behavior, verify the data set name before running the DSN1COMP utility. The fifth-level qualifier in the data set name alternates between 'I0001' and 'J0001' when using FASTSWITCH. If the table space has cloning, the fifth-level qualifier can be 'n0002.' You cannot specify FASTSWITCH YES if the table space has cloning; however, a FASTSWITCH YES REORG might have been done before the clone was created so you might still have a mixture of 'I' and 'J' data sets. Specify the correct fifth-level qualifier in the data set name to successfully execute the DSN1COMP utility. To determine the correct fifth-level qualifier, query the IPREFIX column of SYSIBM.SYSTABLEPART for each data partition or the IPREFIX column of SYSIBM.SYSINDEXPART for each index partition. If the object is not partitioned, use zero as the value for the PARTITION column in your query.

DSN1DICT

DSN1DICT is required only if you specify the EXTNDICT parameter, to create an external copy of the compression dictionary that DSN1COMP produces.

DSN1DICT defines the output data set to which the external copy of the compression dictionary is written. This data set must:

- Be a sequential data set or a member of a partitioned data set
- Have fixed record format with a record length of 80

The data set or data set member that is produced is an object module that can be link-edited into a program.

Recommendation

Before using DSN1COMP, be sure that you know the page size and data set size (DSSIZE) for the table space. Use the following query on the DB2 catalog to get the information you need, in this example for table 'DEPT':

```
SELECT T.CREATOR,T.NAME,S.NAME AS TABLESPACE,S.PARTITIONS,S.PGSIZE,
     CASE S.DSSIZE
     WHEN 0 THEN
                 CASE WHEN S.TYPE = 'G' THEN 4194304
                      WHEN S.TYPE = 'O' THEN 4194304
                      WHEN S.TYPE = 'P' THEN 4194304
                      WHEN S.TYPE = 'R' THEN 4194304
                 ELSE
                      CASE WHEN S.PARTITIONS > 254 THEN
                           CASE WHEN S.PGSIZE = 4  THEN  4194304
                                WHEN S.PGSIZE = 8  THEN  8388608
                                WHEN S.PGSIZE = 16 THEN 16777216
                                WHEN S.PGSIZE = 32 THEN 33554432
                           ELSE NULL
                           END
                           WHEN S.PARTITIONS > 64 THEN 4194304
                           WHEN S.PARTITIONS > 32 THEN 1048576
                           WHEN S.PARTITIONS > 16 THEN 2097152
                           WHEN S.PARTITIONS > 0  THEN 4194304
                      ELSE 2097152
                      END
                 END
```

```
ELSE S.DSSIZE
END
AS DSSIZE
FROM SYSIBM.SYSTABLES T,
     SYSIBM.SYSTABLESPACE S
WHERE
     T.NAME = 'DEPT' AND
     T.TSNAME = S.NAME;
```

Related concepts:

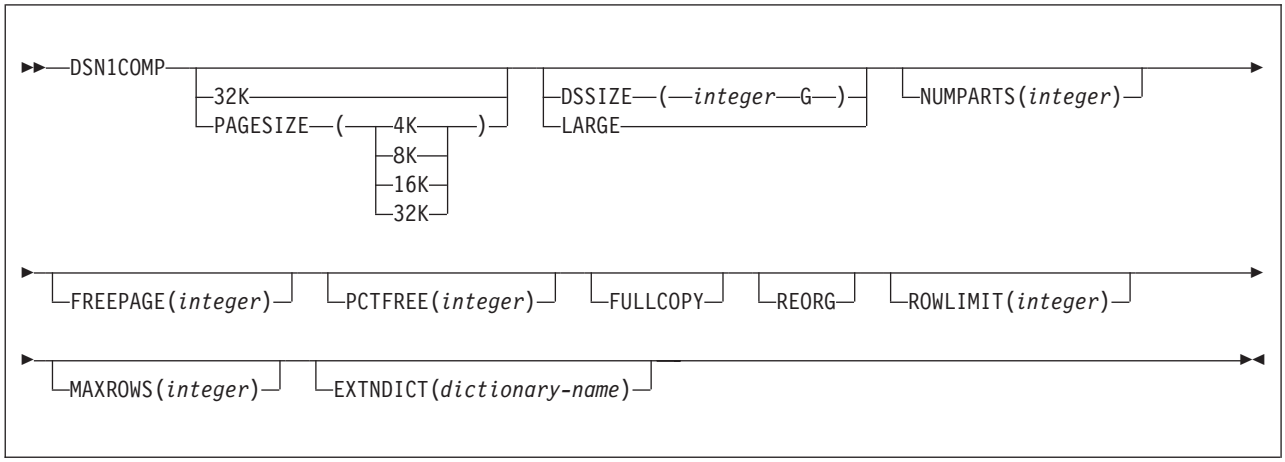
Contents of the log (DB2 Administration Guide)

Syntax and options of the DSN1COMP control statement

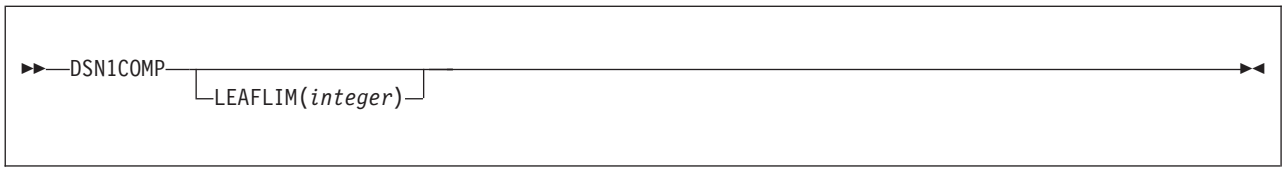
The DSN1COMP utility control statement, with its multiple options, defines the function that the utility job performs.

DSN1COMP syntax diagram

For table spaces:



For indexes:



Option descriptions

To run DSN1COMP, specify one or more of the following parameters on the EXEC statement to run DSN1COMP. If you specify more than one parameter, separate each parameter by a comma. You can specify parameters in any order.

32K

Specifies that the input data set, SYSUT1, has a 32-KB page size. If you specify this option and the SYSUT1 data set does not have a 32-KB page size, DSN1COMP might produce unpredictable results.

The recommended option for performance is **PAGESIZE(32K)**.

PAGESIZE
Specifies the page size of the input data set that is defined by SYSUT1. Available page size values are 4K, 8K, 16K, or 32K. If you specify an incorrect page size, DSN1COMP might produce unpredictable results.

If you omit PAGESIZE, DSN1COMP tries to determine the page size from the input data set. DB2 issues an error message if DSN1COMP cannot determine the input page size. This might happen if the header page is not in the input data set, or if the page size field in the header page contains an invalid page size.

If information on this value is available in the input data set header page, the header page information is the default.

DSSIZE(*integer* **G)**
Specifies the data set size, in gigabytes, for the input data set. If you omit DSSIZE, DB2 obtains the data set size from the data set header page.

If you specify DSSIZE, *integer* must match the DSSIZE value that was specified when the table space was defined.

LARGE
Specifies that the input data set is a table space that was defined with the LARGE option. If you specify LARGE, DB2 assumes that the data set has a 4-GB boundary.

The recommended method of specifying a table space defined with LARGE is **DSSIZE(4G)**.

If you omit the LARGE or DSSIZE(4G) option when it is needed, or if you specify LARGE for a table space that was not defined with the LARGE option, the results from DSN1COMP are unpredictable.

If information on this value is available in the input data set header page, the header page information is the default.

NUMPARTS(*integer***)**
Specifies the number of partitions that are associated with the input data set. Valid specifications range from 1 to 4096. If you omit NUMPARTS or specify it as 0, DSN1COMP assumes that your input file is not partitioned. If you specify a number greater than 64, DSN1COMP assumes that the data set is for a partitioned table space that was defined with the LARGE option, even if the LARGE keyword is not specified.

DSN1COMP cannot always validate the NUMPARTS parameter. If you specify it incorrectly, DSN1COMP might produce unpredictable results.

DSN1COMP terminates and issues message DSN1946I when it encounters an image copy that contains multiple partitions; a compression report is issued for the first partition.

This parameter is not used if the target table space is a universal table space. DSSIZE is used instead.

This parameter is deprecated.

FREEPAGE(*integer***)**
Specifies how often to leave a page of free space when calculating the percentage of saved pages. You must specify an integer in the range 0 to 255. If you specify 0, no pages are included as free space when DSN1COMP reports the percentage of pages saved. Otherwise, one free page is included after every *n* pages, where *n* is the specified integer.

The default value is **0**.

Specify the same value that you specify for the FREEPAGE option of the SQL statement CREATE TABLESPACE or ALTER TABLESPACE.

PCTFREE(*integer***)**
Indicates what percentage of each page to leave as free space when calculating the percentage of pages saved. You must specify an integer in the range 0 to 99. When calculating the savings, DSN1COMP allows for at least *n* percent of free space for each page, where *n* is the specified integer.

The default value is **5**.

Specify the same value that you specify for the PCTFREE option of the SQL statement CREATE TABLESPACE or ALTER TABLESPACE.

FULLCOPY
Specifies that a DB2 full image copy (not a DFSMSdss concurrent copy) of your data is to be used as input. Omitting this parameter when the input is a full image copy can cause error messages or unpredictable results. If this data is partitioned, also specify the NUMPARTS parameter to identify the number of partitions.

REORG
Provides an estimate of compression savings that are comparable to the savings that the REORG utility would achieve. If this keyword is not specified, the results are similar to the compression savings that the LOAD utility would achieve.

ROWLIMIT(*integer***)**
Specifies the maximum number of rows to evaluate in order to provide the compression estimate. This option prevents DSN1COMP from examining every row in the input data set. Valid specifications range from 1 to 99000000.

Use this option to limit the elapsed time and processor time that DSN1COMP requires. An analysis of the first 5 to 10 MB of a table space provides a fairly representative sample of the table space for estimating compression savings. Therefore, specify a ROWLIMIT value that restricts DSN1COMP to the first 5 to 10 MB of the table space. For example, if the row length of the table space is 200 bytes, specifying ROWLIMIT(50000) causes DSN1COMP to analyze approximately 10 MB of the table space.

MAXROWS(*integer***)**
Specifies the maximum number of rows that DSN1COMP is to consider when calculating the percentage of pages saved. You must specify an integer in the range 1 to 255.

The default value is **255**.

Specify the same value that you specify for the MAXROWS option of the SQL statement CREATE TABLESPACE or ALTER TABLESPACE.

EXTNDICT(*dictionary-name***)**
Specifies the name of an external copy of the compression dictionary that DSN1COMP produces. *dictionary-name* must:

- Be eight bytes
- Contain only uppercase alphanumeric characters
- Begin with an alphabetic character

The external copy of the compression dictionary is primarily for use by the IBM Data Encryption for IMS and DB2 tool.

When EXTNDICT is specified, a DSN1DICT DD statement must be included in the JCL for running DSN1COMP.

LEAFLIM(*integer***)**
Specifies how many index leaf pages should be evaluated to determine the compression estimate. This option prevents DSN1COMP from processing all index leaf pages in the input data set. Valid specifications range from 1 to 99000000.

If the LEAFLIM parameter is not specified, the entire index will be scanned and all leaf pages will be examined.

In a compressed index, only leaf pages are compressed. All other page types remain uncompressed.

Related reference:

IBM InfoSphere Guardium Data Encryption for IMS and DB2 Databases

Before running DSN1COMP

Certain activities might be required before you run the DSN1COMP utility, depending on your situation.

If you run DSN1COMP on a segmented table space, you must first query the SYSTABLEPART catalog table to determine the current instance qualifier, which is stored in the IPREFIX column. You can then use the current instance qualifier to code the data set name in the JCL. The following sample shows an example of such a query.

```
SELECT DBNAME, TSNAME, PARTITION, IPREFIX
      FROM SYSIBM.SYSTABLEPART
      WHERE DBNAME = 'DBMC0731' AND TSNAME = 'TPMC0731'
      ORDER BY TSNAME, PARTITION;
```

The preceding query produces the following result:

```
  +-----------------------------------------+
  |  DBNAME  |  TSNAME  | PARTITION | IPREFIX |
  +-----------------------------------------+
1_| DBMC0731 | TPMC0731 |         1 | J       |
2_| DBMC0731 | TPMC0731 |         2 | J       |
3_| DBMC0731 | TPMC0731 |         3 | J       |
4_| DBMC0731 | TPMC0731 |         4 | J       |
5_| DBMC0731 | TPMC0731 |         5 | J       |
  +-----------------------------------------+
```

Figure 120. Result from query on the SYSTABLEPART catalog table to determine the value in the IPREFIX column

The preceding output provides the current instance qualifier (J), which can be used to code the data set name in the DSN1COMP JCL as follows.

```
//STEP1         EXEC PGM=DSN1COMP
//SYSUT1        DD DSN=vcatname.DSNDBC.DBMC0731.J0001.A001,DISP=SHR
//SYSPRINT      DD AYAOUT=*
//SYSUDUMP      DD AYAOUT=*
```

How to estimate compression savings achieved with option REORG

If you run DSN1COMP with the REORG option on small data sets, the resulting estimates might vary greatly from the estimates that are produced without the default REORG option. Alternatively, if you run DSN1COMP and specify a small number (*n*) for ROWLIMIT, the estimates might vary greatly from the estimates that are produced without REORG.

DSN1COMP does not try to convert data to the latest version before it compresses rows and derives a savings estimate.

Without the REORG option, DSN1COMP uses the first *n* rows to fill the compression dictionary. DSN1COMP processes the remaining rows to provide the compression estimate. If the number of rows that are used to build the dictionary is a significant percentage of the data set rows, little savings result. With the REORG option, DSN1COMP processes all the rows, including those that are used to build the dictionary, which results in greater compression.

The DSN1COMP utility determines possible saving estimates at the data set level for a unique partition only. Therefore, if DSN1COMP is run against an image copy data set that contains several partitions or against a single partition of partition-by-growth table spaces (PBGs), the results will be different from what the REORG utility would produce.

Free space in compression calculations on table space

The DSN1COMP utility makes compression estimates, which take into account the PCTFREE and FREEPAGE options.

If you use different PCTFREE or FREEPAGE values than those that were created with the input table space, you get a different value for **noncmppages**. DSN1COMP reports this value in message DSN1940I, as shown in the example output in the following figure.

```
DSN1999I START OF DSN1COMP FOR JOB TST512A  STEP1
DSN1998I INPUT DSNAME = FUFOU237.TSP32K                              , SEQ
DSN1944I DSN1COMP INPUT PARAMETERS
             512  DICTIONARY SIZE USED
              30  FREEPAGE VALUE USED
              45  PCTFREE VALUE USED
                  NO ROWLIMIT WAS REQUESTED
                  ESTIMATE BASED ON DB2 LOAD METHOD

DSN1940I DSN1COMP COMPRESSION REPORT
           1,289  KB WITHOUT COMPRESSION
             717  KB WITH COMPRESSION
              44  PERCENT OF THE BYTES WOULD BE SAVED

             176  ROWS SCANNED TO BUILD DICTIONARY
          20,000  ROWS SCANNED TO PROVIDE COMPRESSION ESTIMATE
             512  DICTIONARY ENTRIES

               1  DICTIONARY PAGES REQUIRED
             147  PAGES REQUIRED WITHOUT COMPRESSION
             148  PAGES REQUIRED WITH COMPRESSION
               0  PERCENT OF THE DB2 DATA PAGES WOULD BE SAVED

   *** DETAIL REPORT OF FREQUENCIES AND AVERAGES ***

     1 CHILD CHARACTER WAS COMPARED                          566,764  TIMES
     2 CHILD CHARACTERS WERE COMPARED                        182,026  TIMES
```

```
3 CHILD CHARACTERS WERE COMPARED                          10,300  TIMES
5 CHILD CHARACTERS WERE COMPARED                           1,129  TIMES
TOTAL ALPHABET NODE COMPARISONS                          528,139  TIMES

            967,361  CHILD COMPARISONS IN THE SIBLING LISTS
            760,219  SEARCHES IN THE SIBLING LISTS
                1.2  AVERAGE NUMBER OF COMPARISONS PER SEARCH
         60  BYTES FOR AVERAGE UNCOMPRESSED ROW LENGTH
         39  BYTES FOR AVERAGE COMPRESSED ROW LENGTH

        263  IS THE DATABASE ID (DBID)
          2  IS THE PAGESET  ID (PSID)
```

Figure 121. Example DSN1COMP output

Sample DSN1COMP control statements

Use the sample control statements as models for developing your own DSN1COMP control statements.

Example 1: Estimating space savings from data compression for a full image copy

The following statement specifies that the DSN1COMP utility is to report the estimated space savings that are to be achieved by compressing the full image copy that is identified by the SYSUT1 DD statement. In this statement, the DSN option specifies the data set name of the image copy that is to be used as input. The fifth qualifier in the data set name can be either I0001 or J0001. This example uses I0001. Note that because the input is a full image copy, the FULLCOPY option must be specified.

```
//jobname JOB acct information
//COMPEST  EXEC PGM=DSN1COMP,PARM='FULLCOPY'
//STEPLIB  DD DSN=prefix.SDSNLOAD,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=DSNCAT.DSNDBC.DB254A.TS254A.I0001.A001,DISP=SHR
```

Example 2: Providing intended free space when estimating space savings

In the following sample statement, STEP1 specifies that DSN1COMP is to report the estimated space savings that are to be achieved by compressing the data in the data set that is identified by the SYSUT1 DD statement, DSNC810.DSNDBD.DB254SP4.TS254SP4.I0001.A00. When calculating these estimates, DSN1COMP considers the values passed by the PCTFREE and FREEPAGE options. The PCTFREE value indicates that 20% of each page is to be left as free space. The FREEPAGE value indicates that every fifth page is to be left as free space. This value must be the same value that you specified for the FREEPAGE option of the SQL statement CREATE TABLESPACE or ALTER TABLESPACE.

STEP2 specifies that DSN1COMP is to report the estimated space savings that are to achieved by compressing the data in the data set that is identified by the SYSUT1 DD statement, DSNC810.DSNDBD.DB254SP4.TS254SP4.I0001.A0001. When providing the compression estimate, DSN1COMP is to evaluate no more than 20 000 rows, as indicated by the ROWLIMIT option. Specifying the maximum number of rows to evaluate limits the elapsed time and processor time that

DSN1COMP requires.

```
//DSN1COMP JOB  MSGLEVEL=(1,1),CLASS=A,MSGCLASS=A,REGION=3000K,
//         USER=SYSADM,PASSWORD=SYSADM
/*ROUTE PRINT STLXXXX.USERID
//STEP1    EXEC PGM=DSN1COMP,PARM='PCTFREE(20),FREEPAGE(5)'
//STEPLIB  DD DSN=prefix.SDSNLOAD,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSDUMP  DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=DSNC110.DSNDBD.DB254SP4.TS254SP4.I0001.A001,DISP=SHR
/*
//STEP2    EXEC PGM=DSN1COMP,PARM='ROWLIMIT(20000)'
//STEPLIB  DD DSN=prefix.SDSNLOAD,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSDUMP  DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=DSNC110.DSNDBD.DB254SP4.TS254SP4.I0001.A001,DISP=SHR
/*
//
```

Figure 122. Example DSN1COMP statements with PCTFREE, FREEPAGE, and ROWLIMIT options

Example 3: Estimating space savings that are comparable to what the REORG utility would achieve.

The following statement specifies that DSN1COMP is to report the estimated space savings that are to be achieved by compressing the data in the data set that is identified by the SYSUT1 DD statement, DSNCAT.DSNDBD.DBJT0201.TPJTO201.I0001.A254. This input data set is a table space that was defined with the LARGE option and has 254 partitions, as indicated by the DSN1COMP options LARGE and NUMPARTS.

The REORG option indicates that DSN1COMP is to provide an estimate of compression savings that is comparable to the savings that the REORG utility would achieve, rather than what the LOAD utility would achieve.

When calculating these estimates, DSN1COMP considers the values passed by the PCTFREE and FREEPAGE options. The PCTFREE value indicates that 30% of each page is to be left as free space. The FREEPAGE value indicates that every thirtieth page is to be left as free space. This value must be the same value that you specified for the FREEPAGE option of the SQL statement CREATE TABLESPACE or ALTER TABLESPACE. DSN1COMP is to evaluate no more than 20 000 rows, as indicated by the ROWLIMIT option.

```
//STEP2  EXEC PGM=DSN1COMP,
//                PARM='LARGE,PCTFREE(30),FREEPAGE(30),NUMPARTS(254),
//            REORG,ROWLIMIT(1000)'
//STEPLIB  DD DSN='USER.TESTLIB',DISP=SHR
//         DD DSN='DB2A.SDSNLOAD',DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSDUMP  DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=DSNCAT.DSNDBD.DBJT0201.TPJT0201.I0001.A254,DISP=SHR
//SYSUT2   DD SYSOUT=A
/*
```

Figure 123. Example DSN1COMP statement with the LARGE, PCTFREE, FREEPAGE, NUMPARTS, REORG, and ROWLIMIT options.

Example 4: Building an Object Module from the DSN1COMP generated dictionary.

In the sample statement, BUILD specifies that DSN1COMP is to externalize the compression dictionary that it generated. This behavior is indicated by the EXTNDICT option, which requires that a DSN1DICT DD statement be provided. DSN1DICT identifies the output data set to which the generated object module is written and stored for additional processing.

```
//BUILD    EXEC PGM=DSN1COMP,
// PARM='DSSIZE(4G),EXTNDICT(dictname)'
//SYSPRINT DD  SYSOUT=A
//SYSUT1   DD DSN=DSNCAT.DSNDBD.DBIA2401.TPIA2401.I0001.A254,
//            DISP=SHR
//DSN1DICT DD DSN=&&OBJ,
//         DISP=(,PASS),
//         UNIT=SYSALLDA,SPACE=(TRK,(8,4)),
//         DCB=(LRECL=80,BLKSIZE=4000,RECFM=FB)
```

Figure 124. Example DSN1COMP statement with the EXTNDICT option.

DSN1COMP output

The output of the DSN1COMP utility lists a variety of information.

Message DSN1941

If you receive this message, use a data set with more rows as input, or specify a larger ROWLIMIT.

Sample DSN1COMP report

The following figure shows a sample of the output that DSN1COMP generates.

```
DSN1940I DSN1COMP COMPRESSION REPORT
             301  KB WITHOUT COMPRESSION
             224  KB WITH COMPRESSION
              25  PERCENT OF THE BYTES WOULD BE SAVED

           1,975  ROWS SCANNED TO BUILD DICTIONARY
           4,665  ROWS SCANNED TO PROVIDE COMPRESSION ESTIMATE
           4,096  DICTIONARY ENTRIES

              81  BYTES FOR AVERAGE UNCOMPRESSED ROW LENGTH
              52  BYTES FOR AVERAGE COMPRESSED ROW LENGTH

              16  DICTIONARY PAGES REQUIRED
             110  PAGES REQUIRED WITHOUT COMPRESSION
              99  PAGES REQUIRED WITH COMPRESSION
              10  PERCENT OF THE DB2 DATA PAGES WOULD BE SAVED
```

Figure 125. Sample DSN1COMP report

Example of DSN1COMP on an index

The following figure shows an example of the output that DSN1COMP on an index generates.

```
DSN1999I START OF DSN1COMP FOR JOB DSN1COMP STEP2
DSN1998I INPUT DSNAME = TESTCAT.DSNDBD.DB1COMPR.I1.I0001.A001       , VSAM

DSN1944I DSN1COMP INPUT PARAMETERS
                  PROCESSING PARMS FOR INDEX DATASET:
```

```
                NO LEAFLIM WAS REQUESTED

DSN1940I DSN1COMP COMPRESSION REPORT

             38  Index Leaf Pages Processed
          3,000  Keys Processed
          3,000  Rids Processed
            401  KB of Key Data Processed
            106  KB of Compressed Keys Produced


                EVALUATION OF COMPRESSION WITH DIFFERENT INDEX PAGE SIZES:

                ---------------------------------------------
              8  K Page Buffer Size yields a
             51  % Reduction in Index Leaf Page Space
                 The Resulting Index would have approximately
             49  % of the original index's Leaf Page Space
                 No Bufferpool Space would be unused
                 ---------------------------------------------

                 ---------------------------------------------
             16  K Page Buffer Size yields a
             74  % Reduction in Index Leaf Page Space
                 The Resulting Index would have approximately
             26  % of the original index's Leaf Page Space
              3  % of Bufferpool Space would be unused to
                 ensure keys fit into compressed buffers
                 ---------------------------------------------

DSN1994I DSN1COMP COMPLETED SUCCESSFULLY,            38  PAGES PROCESSED
```

Figure 126. Sample DSN1COMP output

Chapter 44. DSN1COPY

You can use the DSN1COPY stand-alone utility to copy DB2 VSAM data sets.

With the DSN1COPY stand-alone utility, you can copy:
- DB2 VSAM data sets to sequential data sets
- DSN1COPY sequential data sets to DB2 VSAM data sets
- DB2 image copy data sets to DB2 VSAM data sets
- DB2 VSAM data sets to other DB2 VSAM data sets
- DSN1COPY sequential data sets to other sequential data sets

A DB2 VSAM data set is one of the following items:
- a single piece of a nonpartitioned table space or index
- a single partition of a partitioned table space or index
- a FlashCopy image copy data set

The input must be a single z/OS sequential or VSAM data set. Concatenation of input data sets is not supported.

You can also use DSN1COPY to perform the following actions:
- Print hexadecimal dumps of DB2 data sets and databases
- Check the validity of data or index pages (including dictionary pages for compressed data)
- Translate database object identifiers (OBIDs) to enable moving data sets between different systems
- Reset to 0 the log RBA that is recorded in each index page or data page.

You cannot run DSN1COPY on concurrent copies.

DSN1COPY can operate on both base and clone objects.

You can use the DSN1COPY utility on LOB table spaces by specifying the LOB keyword and omitting the SEGMENT and INLCOPY keywords.

DB2 managed data sets can be moved from HDD to SSD by using DSN1COPY.

Output

One intended use of this utility is to aid in determining and correcting system problems. When diagnosing DB2, you might need to refer to licensed documentation to interpret output from this utility.

After a data set is populated by DSN1COPY, the first time that it is physically opened by an operation other than a utility, DB2 checks for any data and catalog inconsistencies for the following items:
- DBID, PSID, and OBID
- SEGSIZE and PAGESIZE
- Table space type
- Table schema (DB2 checks this item if the table space contains only one table, and an OBDREC is stored in the system page.)

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DB2 reports any inconsistencies with a -904 SQL code, and you cannot access the data.

DB2 does not check these items for LOB or XML table spaces. DB2 also does not validate record row format or RBA format.

Also, several exception situations exist. DB2 does not check for data and catalog inconsistencies during the following situations:

- The data set is physically opened by a utility, including the REPAIR utility.
- DB2 is restarting.
- The header page is not formatted yet.
- The REPAIR utility is operating on the header page. (The REPAIR utility closes the page set when it is finished. Therefore, validation can be done the next time that the data set is physically opened.)
- The LOGAPPLY phase of the RECOVER utility is processing.

By not checking for inconsistencies during these situations, DB2 limits any performance impact.

If any inconsistencies are reported, you can correct them by using the REPAIR utility with the CATALOG option.

Related information:

Types of DB2 table spaces (Introduction to DB2 for z/OS)

"Syntax and options of the REPAIR control statement" on page 664

Environment

Run DSN1COPY as a z/OS job when the DB2 subsystem is either active or not active.

If you run DSN1COPY when DB2 is active, use the following procedure:

1. Start the table space as read-only by using START DATABASE.
2. Run the QUIESCE utility with the WRITE (YES) option to externalize all data pages and index pages.
3. Run DSN1COPY with DISP=SHR on the data definition (DD) statement.
4. Start the table space as read/write by using START DATABASE to return to normal operations.

Authorization required

DSN1COPY does not require authorization. However, if any of the data sets is protected by RACF, the authorization ID of the job must have RACF authority.

Restrictions

DSN1COPY does not alter data set structure. For example, DSN1COPY does not copy a partitioned or segmented table space into a simple table space. The output data set is a page-for-page copy of the input data set. If the intended use of DSN1COPY is to move or restore data, ensure that definitions for the source and target table spaces, tables, and indexes are identical. Otherwise, unpredictable results can occur.

DSN1COPY cannot copy DB2 recovery log data sets. The format of a DB2 log page is different from the format of a table or index page. If you try to use DSN1COPY to recover log data sets, DSN1COPY abnormally terminates.

For a compressed table space, DSN1COPY does not reset the dictionary version for the following items:

- an inline image copy
- an incremental image copy that was created with the SYSTEMPAGES=YES COPY utility option

To reset the dictionary version for an inline image copy, use the inline image copy as input to DSN1COPY with a VSAM intermediate data set as output. This intermediate data set can then be used as input to DSN1COPY RESET to copy the intermediate data set to the real target data set.

All the target data sets must exist. You can use Access Method Services to define them.

DSN1COPY issues an error and terminates in the following situations:

- DSN1COPY can verify that the LOB option is specified, but the data set is not a LOB data set.
- The LOB option is omitted for a data set that is a LOB data set.

To avoid problems, always specify the LOB option if the input data set SYSUT1 is a LOB table space, and make sure that the LOB option is not specified for non LOB table spaces.

DSN1COPY cannot copy a source object of 4 GB or greater in size when it is full unless the target object is EA-enabled. For example, the source is full when it is not the last piece of a multi-piece non-partitioned object with a DSSIZE of 4 GB or greater. To avoid VSAM errors and limit each piece to 2 GB so that the target object has more pieces than the original source:

- Define the target data set as EA-enabled and use DSN1COPY to copy the data, one piece at a time, from the source that is not EA-enabled to the target.
- If it is not possible to define the target data set as EA-enabled:
  1. Take a full image copy of the entire source object by running the COPY utility and specifying DSNUM ALL.
  2. Create the target object by specifying DSSIZE 2GB for table spaces and PIECESIZE 2GB for indexes. See “Copying tables from one subsystem to another” on page 972.
  3. Define the partition number data sets (2 GB each) with the IDCAMS command. Define enough pieces to hold the entire source.
  4. Run the DSN1COPY utility with the image copy as the source (SYSUT1), the target object as SYSUT2, and specify DSSIZE 2G.

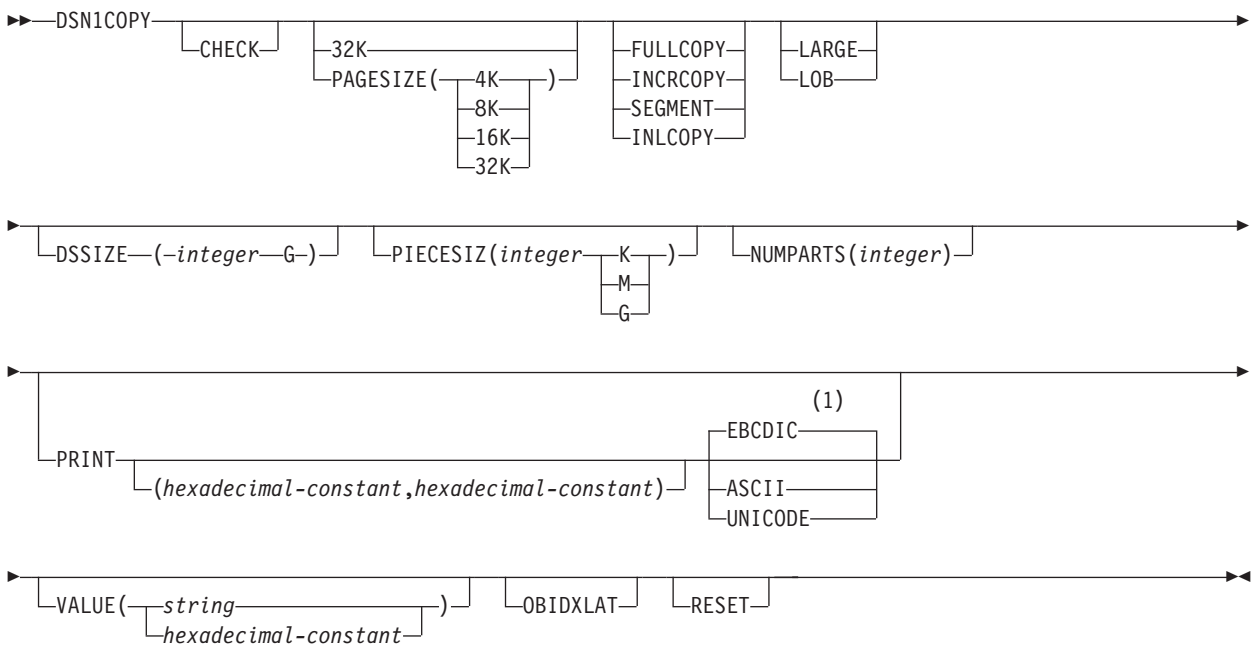
DSN1COPY cannot be used to restore data to a point in time before materialization of pending definition changes.

For partition-by-growth table spaces, DSN1COPY can be used only if the number of active or existing partitions of the source and the target table space are the same. Otherwise, use the UNLOAD utility to unload the data from the source table space and the LOAD utility to reload the data into the target table space.

Syntax and options of the DSN1COPY control statement

The DSN1COPY utility control statement, with its multiple options, defines the function that the utility job performs.

DSN1COPY syntax diagram



Notes:

1 EBCDIC is not necessarily the default if the first page of the input data set is a header page. If the first page is a header page, DSN1COPY uses the format information in the header page as the default format.

Option descriptions

To run DSN1COPY with invocation parameters, specify one or more of the following parameters on the EXEC statement. If you specify more than one parameter, separate each parameter by a comma. You can specify parameters in any order.

Default settings for DSN1COPY options are taken from the input data set header page. This default processing is recommended when running DSN1COPY because incorrect parameter settings can result in unpredictable results.

When non-default user values are specified, DSN1COPY compares the input data set header page settings against user-specified values whenever possible. If a mismatch is detected, message DSN1930I is issued. The processing is performed with the user-specified values

CHECK
Checks each page from the SYSUT1 data set for validity. The validity checking operates on one page at a time and does not include any cross-page checking.

If an error is found, a message is issued describing the type of error, and a dump of the page is sent to the SYSPRINT data set. If an unexpected page number is encountered, validity checking continues to the end and a report will be printed of all unexpected page numbers. If you do not receive any messages, no errors were found. If more than one error exists in a given page, the check identifies only the first of the errors. However, the entire page is dumped. DSN1COPY does not check system pages for validity.

An index with BUSINESS_TIME period columns appended to the key for BUSINESS TIME WITHOUT OVERLAPS bypasses checking for orderly keys.

32K
Specifies that the SYSUT1 data set has a 32-KB page size. If you specify this option and the SYSUT1 data set does not have a 32-KB page size, DSN1COPY might produce unpredictable results that might be undetected until later.

PAGESIZE
Specifies the page size of the input data set that is defined by SYSUT1. Available page size values are 4K, 8K, 16K, or 32K. If you specify an incorrect page size, DSN1COPY might produce unpredictable results.

If you do not specify the page size, DSN1COPY tries to determine the page size from the input data set if the first page of the input data set is a header page. DB2 issues an error message if DSN1COPY cannot determine the input page size. This might happen if the header page is not in the input data set, or if the page size field in the header page contains an invalid page size.

FULLCOPY
Specifies that a DB2 full image copy (not a DFSMSdss concurrent copy) of your data is to be used as input. If this data is partitioned, specify NUMPARTS to identify the total number of partitions. If you specify FULLCOPY without NUMPARTS, DSN1COPY determines the NUMPARTS value from the header page if possible; otherwise, DSN1COPY assumes that your input file is not partitioned.

Specify FULLCOPY when using a full image copy as input. Omitting the parameter can cause error messages or unpredictable results.

Do not specify FULLCOPY if you are using a FlashCopy image copy data set as input.

The FULLCOPY parameter requires SYSUT2 (output data set) to be either a DB2 VSAM data set or a DUMMY data set.

INCRCOPY
Specifies that an incremental image copy of the data is to be used as input. DSN1COPY with the INCRCOPY parameter updates existing data sets; do not redefine the existing data sets. INCRCOPY requires that the output data set (SYSUT2) be a DB2 VSAM data set.

Before you apply an incremental image copy to your data set, you must first apply a full image copy to the data set by using the FULLCOPY parameter. Make sure that you apply the full image copy in a separate execution step because you receive an error message if you specify both the FULLCOPY and the INCRCOPY parameters in the same step. Then, apply each incremental image copy in a separate step, starting with the oldest incremental image copy.

Specifying neither FULLCOPY nor INCRCOPY implies that the input is not an image copy data set. Therefore, only a single output data set is used.

SEGMENT
Specifies that you want to use a segmented table space as input to DSN1COPY.

Pages with all zeros in the table space are copied, but no error messages are issued. You cannot specify FULLCOPY or INCRCOPY if you specify SEGMENT.

If you are using DSN1COPY with the OBIDXLAT to copy a DB2 data set to another DB2 data set, the source and target table spaces must have the same SEGSIZE attribute.

You cannot specify the SEGMENT option with the LOB parameter.

INLCOPY
Specifies that the input data is an inline copy data set. The INLCOPY parameter requires SYSUT2 (output data set) to be either a VSAM data set or a DUMMY data set.

You cannot specify the INLCOPY option with the LOB parameter.

DSSIZE(*integer* **G)**
Specifies the data set size, in gigabytes, for the input data set. If you omit DSSIZE, DB2 obtains the data set size from the data set header page.

If you specify DSSIZE, *integer* must match the DSSIZE value that was specified when the table space was defined.

LARGE
Specifies that the input data set is a table space that was defined with the LARGE option, or an index on such a table space. If you specify the LARGE keyword, DB2 assumes that the data set has a 4-GB boundary. The recommended method of specifying a table space that was defined with the LARGE option is **DSSIZE(4G)**.

If you omit the LARGE or DSSIZE(4G) option when it is needed, or if you specify LARGE for a table space that was not defined with the LARGE option, the results from DSN1COPY are unpredictable.

If you specify LARGE, you cannot specify LOB or DSSIZE.

LOB
Specifies that SYSUT1 data set is a LOB table space. Empty pages in the table space are copied, but no error messages are issued. You cannot specify the SEGMENT and INLCOPY options with the LOB parameter.

DSN1COPY attempts to determine if the input data set is a LOB data set. If it can be clearly verified that the LOB option is specified, but the data set is not a LOB data set, or that the LOB option is omitted for a data set that is a LOB data set, DSN1COPY issues an error message and terminates. Otherwise, if the LOB option isn't specified or omitted correctly the results of DSN1COPY are unpredictable.

If you specify LOB, you cannot specify LARGE.

NUMPARTS(*integer***)**
Specifies the number of partitions that are associated with the input data set. Valid specifications range from 1 to 4096. If you omit NUMPARTS or specify it as 0, DSN1COPY assumes that your input file is not partitioned. If you specify a number greater than 64, DSN1COPY assumes that the data set is for a partitioned table space that was defined with the LARGE option, even if the LARGE keyword is not specified.

DSN1COPY cannot always validate the NUMPARTS parameter. If you specify it incorrectly, DSN1COPY might produce unpredictable results.

DSN1COPY terminates and issues message DSN1946I when it encounters an image copy that contains multiple partitions; a compression report is issued for the first partition.

This parameter is not used if the target table space is a universal table space. DSSIZE is used instead.

This parameter is deprecated.

PRINT(*hexadecimal-constant*,*hexadecimal-constant***)**
Causes the SYSUT1 data set to be printed in hexadecimal format on the SYSPRINT data set. You can specify the PRINT parameter with or without the page range specifications (*hexadecimal-constant*,*hexadecimal-constant*). If you do not specify a range, all pages of the SYSUT1 are printed. If you want to limit the range of pages that are printed, indicate the beginning and ending page. If you want to print a single page, supply only that page number. In either case, your range specifications must be from one to eight hexadecimal characters in length.

The following example shows how you code the PRINT parameter if you want to begin printing at page X'2F0' and stop at page X'35C':

```
PRINT(2F0,35C)
```

Because the CHECK and RESET options and the copy function run independently of the PRINT range, these options apply to the entire input file, regardless of whether a range of pages is being printed.

You can indicate the format of the row data in the PRINT output by specifying EBCDIC, ASCII, or UNICODE.

EBCDIC
Indicates that the row data in the PRINT output is to be displayed in EBCDIC. The default value is **EBCDIC** if the first page of the input data set is not a header page.

If the first page is a header page, DSN1COPY uses the format information in the header page as the default format. However, if you specify EBCDIC, ASCII, or UNICODE, that format overrides the format information in the header page. The unformatted header page dump is always displayed in EBCDIC, because most of the fields are in EBCDIC.

ASCII
Indicates that the row data in the PRINT output is to be displayed in ASCII. Specify ASCII when printing table spaces that contain ASCII data.

UNICODE
Indicates that the row data in the PRINT output is to be displayed in Unicode. Specify UNICODE when printing table spaces that contain Unicode data.

PIECESIZ(*integer***)**
Specifies the maximum piece size (data set size) for nonpartitioned indexes. The value that you specify must match the value that was specified when the nonpartitioning index was created or altered. The defaults for PIECESIZ are 2G (2 GB) for indexes that are backed by non-large table spaces and 4G (4 GB) for indexes that are backed by table spaces that were defined with the LARGE option. This option is required if the piece size is not one of the default values. If PIECESIZ is omitted and the index is backed by a table space that was defined with the LARGE option, the LARGE option is required for DSN1COPY.

The subsequent keyword K, M, or G indicates the unit of the value that is specified in *integer*.

K Indicates that the *integer* value is to be multiplied by 1 KB to specify the maximum piece size in bytes. *integer* must be either 256 or 512.

M Indicates that the *integer* value is to be multiplied by 1 MB to specify the maximum piece size in bytes. *integer* must be a power of two, between 1 and 512.

G Indicates that the *integer* value is to be multiplied by 1 GB to specify the maximum piece size in bytes. *integer* must be a power of two, between 1 and 256.

Valid values for piece size are:
- 1 MB or 1 GB
- 2 MB or 2 GB
- 4 MB or 4 GB
- 8 MB or 8 GB
- 16 MB or 16 GB
- 32 MB or 32 GB
- 64 MB or 64 FB
- 128 MB or 128 GB
- 256 KB, 256 MB, or 256 GB
- 512 KB or 512 MB

VALUE

Causes each page of the SYSUT1 input data set to be scanned for the character string that you specify in parentheses following the VALUE parameter. Each page that contains that character string is printed in the SYSPRINT data set. You can specify the VALUE parameter in conjunction with any of the other DSN1COPY parameters.

string can consist of 1 to 20 alphanumeric characters.

hexadecimal-constant can consist of 2 to 40 hexadecimal characters. Specify two apostrophe characters before and after the hexadecimal character string.

If you want to search your input file for the string '12345', your JCL should look similar to the following JCL:

```
//STEP1 EXEC PGM=DSN1COPY,PARM='VALUE(12345)'
```

Alternatively, you might want to search for the equivalent hexadecimal character string. If you are processing Unicode or ASCII input files, you must specify the string in hexadecimal. Your JCL should look similar to the following JCL:

```
//STEP1 EXEC PGM=DSN1COPY,PARM='VALUE(''3132333435'')'
```

OBIDXLAT

Specifies that OBID translation must be done before the DB2 data set is copied. OBID translation is needed when the source and target OBIDs do not match.

This parameter requires additional input from the SYSXLAT file by using the DD statements. DSN1COPY can translate only up to 10000 record OBIDs.

If you specify OBIDXLAT, CHECK processing is performed, regardless of whether you specify the CHECK option.

Related information:

"The effects of not specifying the OBIDXLAT option" on page 968

RESET

Causes the log RBAs in each index page or data page and the high-formatted page number in the header page to be reset to 0. If you specify this option, CHECK processing is performed, regardless of whether you specify the CHECK option.

Use RESET when the output file is used to build a DB2 table space that is to be processed on a DB2 subsystem with a different recovery log than the source subsystem. Failure to specify RESET in such a case can result in an abend during subsequent update activity. The abend reason code of 00C200C1 indicates that the specified RBA value is outside the valid range of the recovery log. A condition code of 0 indicates successful completion.

Do not specify the RESET parameter for page sets that are in group buffer pool RECOVER-pending (GRECP) status.

For a compressed table space, DSN1COPY does not reset the dictionary version for an inline image copy, or for an incremental image copy that was created with the SYSTEMPAGES=YES COPY utility option.

If you do not specify RESET when copying a table space from one DB2 system to another, a down-level ID check might result in abend reason code 00C2010D when the table space is accessed.

Related information:

Recovering from a down-level page set problem (DB2 Administration Guide)

Before running DSN1COPY

Certain activities might be required before you run the DSN1COPY utility, depending on your situation.

Attention: Do not use DSN1COPY in place of COPY for both backup and recovery. Improper use of DSN1COPY can result in unrecoverable damage and loss of data.

Recommendations

Printing with DSN1PRNT instead of DSN1COPY

If you require only a printed hexadecimal dump of a data set, use DSN1PRNT rather than DSN1COPY.

Copying a table space with DSN1COPY with row formats

When you use a DSN1COPY of a table space to populate another table space, the row formats of the two table spaces must match. If the row formats do not match, the results are unpredictable and could cause integrity problems.

To determine the source table space and target table space row format, run the following query against your DB2 catalog:

```
SELECT DBNAME, TSNAME, PARTITION, FORMAT
   FROM SYSIBM.SYSTABLEPART
   WHERE (DBNAME = 'source-database-name'
   AND TSNAME='source-table-space-name')
   OR    (DBNAME = 'target-database-name'
   AND TSNAME='target-table-space-name')
```

If the FORMAT column has a value of 'R', then the table space or partition is in RRF (reordered row format). If the FORMAT column has a blank value, then the table space or partition is in BRF (basic row format).

Determining page size and DSSIZE

Before using DSN1COPY, ensure that you know the page size and data set size (DSSIZE) for the page set. Use the following query on the DB2 catalog to get the information you need in this example for table 'DEPT':

```
SELECT T.CREATOR,T.NAME,S.NAME AS TABLESPACE,S.PARTITIONS,S.PGSIZE,
     CASE S.DSSIZE
     WHEN 0 THEN
                 CASE WHEN S.TYPE = 'G' THEN 4194304
                      WHEN S.TYPE = 'O' THEN 4194304
                      WHEN S.TYPE = 'P' THEN 4194304
                      WHEN S.TYPE = 'R' THEN 4194304
                 ELSE
                      CASE WHEN S.PARTITIONS > 254 THEN
                           CASE WHEN S.PGSIZE = 4  THEN  4194304
                                WHEN S.PGSIZE = 8  THEN  8388608
                                WHEN S.PGSIZE = 16 THEN 16777216
                                WHEN S.PGSIZE = 32 THEN 33554432
                           ELSE NULL
                           END
                           WHEN S.PARTITIONS > 64 THEN 4194304
                           WHEN S.PARTITIONS > 32 THEN 1048576
                           WHEN S.PARTITIONS > 16 THEN 2097152
                           WHEN S.PARTITIONS > 0  THEN 4194304
                      ELSE 2097152
                      END
                 END
      ELSE S.DSSIZE
      END
      AS DSSIZE
      FROM SYSIBM.SYSTABLES T,
           SYSIBM.SYSTABLESPACE S
      WHERE
           T.NAME = 'DEPT' AND
           T.TSNAME = S.NAME;
```

Figure 127. Example catalog query that returns the page set size and data set size for the page set.

Using the OBIDXLAT option with DSN1COPY

When you use DSN1COPY with the OBIDXLAT option to move objects from one system to another system, ensure that the version information on the target system matches the version information on the source version.

Copying a range-partitioned or partition-by-growth table space

When you use DSN1COPY on a range-partitioned or partition-by-growth table space, use the SEGMENT and NUMPARTS options to process the table space. For partition-by-growth table spaces, the NUMPART value specified should be the MAXPARTITIONS value that the table space was created with.

Copying when pending alterations exist

Before you use DSN1COPY, ensure that the schema of the source and target objects match.

You might also need to run the REORG TABLESPACE utility to materialize pending alterations depending on the following conditions:

- If the pending alterations are for an added or dropped column, run REORG TABLESPACE.
- If the pending alteration are for a changed data type, you need to either insert or update at least one row or run REORG TABLESPACE.

After you run DSN1COPY, run REPAIR CATALOG.

Related information:

"Syntax and options of the REPAIR control statement" on page 664

Copying a versioned XML table space

Before using DSN1COPY to copy a versioned XML table space, ensure that the definitions of the XML columns START_TS and END_TS match.

Altering a table

When you use ALTER TABLE ADD COLUMN, the table does not change; only the description of the table changes. Before you run DSN1COPY on the table space, run REORG on the table space (so that the data matches its description).

Related concepts:

Table space versions (DB2 Administration Guide)

Related tasks:

"Copying tables from one subsystem to another" on page 972

Data sets that DSN1COPY uses

The DSN1COPY utility uses a number of data sets during its operation.

Required data sets

DSN1COPY uses the following data sets:

Input data set
Input to DSN1COPY. The DD name is SYSUT1.

Output data set
Output from DSN1COPY. The DD name is SYSUT2. Optional.

Message data set
Data set for output messages. The DD name is SYSPRINT.

OBIDXLAT data set
Data set that defines the OBID translation values. The DD name is SYSXLAT.

DSN1COPY uses the following DD statements:

SYSPRINT
Defines the data set that contains output messages from the DSN1COPY program and all hexadecimal dump output.

SYSUT1

Defines the input data set. This data set can be a sequential data set that is created by the DSN1COPY or COPY utilities, or a VSAM data set, including a FlashCopy image copy data set.

Specify the data set's disposition as DISP=OLD to ensure that it is not in use by DB2. Specify the data set's disposition as DISP=SHR only when the DB2 STOP DATABASE command does not work.

The requested operation takes place only for the specified data set. If the input data set is a partitioned table space or index, ensure that you specify the NUMPARTS parameter and the correct data set. For example, to print a

page range in the second partition of a four-partition table space, specify NUMPARTS(4) and the data set name of the second data set. This second data set is in the group of VSAM data sets, and the VSAM data set name is DSNCAT.DSNDBD.TESTDB.TS01.I0001.A002. The last qualifier (A002) represents the partition number 2.

To copy the data sets for a segmented table space that consists of multiple data sets, you need to run multiple DSN1COPY jobs. Run one job for each data set in the table space.

If running the online REORG utility with the FASTSWITCH option, verify the data set name before running the DSN1COPY utility. The fifth-level qualifier in the data set name alternates between I0001 and J0001 when using FASTSWITCH. If the table space has cloning or ever had cloning, the fifth-level qualifier can be I0002 or J0002. You cannot specify FASTSWITCH YES if the table space has cloning; however, a FASTSWITCH YES REORG might have been done before the clone was created so you might still have a mixture of 'I' and 'J' data sets. Specify the correct fifth-level qualifier in the data set name to successfully execute the DSN1COPY utility. To determine the correct fifth-level qualifier, query the IPREFIX column of SYSIBM.SYSTABLEPART for each data partition or the IPREFIX column of SYSIBM.SYSINDEXPART for each index partition. If the object is not partitioned, use zero as the value for the PARTITION column in your query.

To determine the instance number to use for a fifth-level qualifier, query the INSTANCE column of SYSIBM.SYSTABLESPACE. The returned value is the instance number that represents the current base objects. The clone objects would be represented by the other instance number. If a query of SYSTABLESPACE.INSTANCE returns a value of 2, then the base objects are represented by instance number 2 data sets and the clone objects by instance number 1 data sets. This process can be used to determine the instance number even if there is no active cloning.

SYSUT2

Defines the output data set. This data set can be a sequential data set, a VSAM data set, or a DUMMY data set.

What you specify for SYSUT2 is restricted if both of the following conditions are true:

- SYSUT1 is an image copy of an entire partitioned table space or an image copy of all data sets of a multi-piece object
- The data is to be copied to a DB2 table space or DB2 index space

In this case, SYSUT2 must be the name of first data set (of the first partition or of the first piece) for the table space or index space. The names of those data sets must follow the format that is defined in Data set naming conventions (DB2 Administration Guide). For example, the last part of the name must identify the data set number A001.

DSN1COPY identifies the appropriate output data set by the page number and allocates other data sets for additional partitions. The names of these data sets also follow the DB2 data set naming conventions. For example, these data set names end with A002, A003, and so on.

All target data sets must be defined. To define the data sets for a multi-piece object, create first the table space or index with DEFINE YES and specify appropriate primary and secondary quantities. If -1 is specified for primary and/or secondary quantity DSN1COPY may run out of extents

because DB2 defines the first data set with small primary and/or secondary extents in this case. DB2 then defines the first data set. The subsequent data sets can be defined by using Access Method Services. See "Copying tables from one subsystem to another" on page 972 for more information.

DSN1COPY assumes that the output data sets are empty (that is, the program adds the blocks) except when you specify INCRCOPY. Before you run DSN1COPY, define your VSAM output data sets as REUSE. If you have not defined the data sets, you must redefine all VSAM output data sets you are restoring by using Access Method Services. Ensure that these data sets are empty before you run DSN1COPY.

You might want to specify a DUMMY SYSUT2 DD statement if you are dumping or checking pages.

To enable DB2 to obtain necessary information from the integrated catalog facility catalog when using VSAM data sets, do not code the unit-serial parameter and volume-serial parameter.

If running the online REORG utility with the FASTSWITCH option, verify the data set name before running the DSN1COPY utility. The fifth-level qualifier in the data set name alternates between I0001 and J0001 when using FASTSWITCH. Specify the correct fifth-level qualifier in the data set name to successfully execute the DSN1COPY utility.

SYSXLAT

Defines for translation the DBIDs, OBIDs, data page set identifiers (PSIDs), or index page set identifiers (ISOBIDs).

If you have dropped a table without a subsequent REORG of the table space, you must reorganize the source table space before running DSN1COPY with the OBIDXLAT option. This action removes any previously dropped records from the table space.

A non-numeric character must separate each record in the SYSXLAT file, and each record must contain a pair of decimal integers. The first integer of each record pertains to the source, and the second integer pertains to the target. The first record in the SYSXLAT file contains the source DBIDs and the target DBIDs; the values can range from -32767 to 65535. The second record contains the source and target PSIDs or ISOBIDs; the values can range from 0 to 32767. All subsequent records in the SYSXLAT data set are for table OBIDs. For an index, the SYSXLAT data set must contain the index fan set OBID, in addition to the DBID and ISOBID. Sample data in a SYSXLAT file follows (with an indication of how each record translates shown in parentheses):

```
260,280 (source DBID 260 translates to target DBID 280)
2,10    (source PSID 2 translates to target PSID 10)
3,55    (source table OBID 3 translates to target table OBID 55)
6,56    (source table OBID 6 translates to target table OBID 56)
7,57    (source table OBID 7 translates to target table OBID 57
```

To obtain the names, DBIDs, PSIDs, ISOBIDs, and OBIDs, run the DSNTEP2 sample application on both the source and target systems. The following SQL statements yield the preceding information.

The example for indexes yields output that is similar to the preceding example, but with an additional column of data.

PSPI For table spaces use the following statements:

```
SELECT DBID, PSID FROM SYSIBM.SYSTABLESPACE
   WHERE NAME='tablespace_name'
     AND DBNAME='database_name';
SELECT NAME, OBID FROM SYSIBM.SYSTABLES
   WHERE TSNAME='tablespace_name'
     AND CREATOR='creator_name';
```

For index spaces use the following statement:

```
SELECT DBID, ISOBID, OBID FROM SYSIBM.SYSINDEXES
   WHERE NAME='index_name'
     AND CREATOR='creator_name';
```

PSPI

Several examples of using DSN1COPY follow:

- Create a backup copy of a DB2 data set:
  - SYSUT1: DB2-VSAM
  - SYSUT2: Sequential data set
- Restore a backup copy of a DB2 data set:
  - SYSUT1: DSN1COPY sequential data set
  - SYSUT2: DB2-VSAM
- Move a DB2 data set to another DB2 data set:
  - SYSUT1: DB2-VSAM
  - SYSUT2: DB2-VSAM
  - Parameters: OBIDXLAT, RESET
- Perform validity checking on a DB2 data set:
  - SYSUT1: DB2-VSAM
  - SYSUT2: DUMMY
  - Parameter: CHECK
- Perform validity checking on and print a DB2 data set:
  - SYSUT1: DB2-VSAM
  - SYSUT2: DUMMY
  - Parameters: CHECK, PRINT
- Restore a table space from a nonpartitioned image copy data set or page set:
  - SYSUT1: DB2 full image copy
  - SYSUT2: DB2-VSAM
  - Parameter: FULLCOPY
- Restore a table space from a partitioned image copy data or page set:
  - SYSUT1: DB2 full image copy
  - SYSUT2: DB2-VSAM
  - Parameters: FULLCOPY, NUMPARTS(*nn*)
- Perform RBA RESET on a DB2 data set:
  - SYSUT1: DB2-VSAM or DSN1COPY sequential data set
  - SYSUT2: DB2-VSAM
  - Parameter: RESET

Defining the input data set

The SYSUT1 data set can be any of the following types:

- A DB2 table space data set
- A DB2 index space data set
- A sequential full image copy
- An incremental image copy
- An inline image copy
- A sequential data set that was previously created by DSN1COPY

- A FlashCopy image copy data set

Define SYSUT1 with DISP=OLD to ensure that DSN1COPY uses it exclusively. If SYSUT1 is a table space or index space, use the following procedure before using DSN1COPY:

GUPI

1. Issue the following command to determine if the object is stopped:
   ```
   -DISPLAY DATABASE (database_name) SPACENAM(space_name) RESTRICT
   ```
2. If DB2 has not stopped the object, issue the following command to stop the object:
   ```
   -STOP DATABASE (database_name) SPACENAME(space_name)
   ```

GUPI

DB2 allows input of only one DSN1COPY data set. DB2 does not permit the input of concatenated data sets. For a table space that consists of multiple data sets, ensure that you specify the correct data set. For example, if you specify the CHECK option to validate pages of a partitioned table space's second partition, code the second data set of the table space for SYSUT1.

Defining the output data set

The SYSUT2 data set can be any of the following types:
- A sequential data set
- A DB2 table space data set
- A DB2 index space data set
- A DUMMY data set

Specify a DUMMY SYSUT2 DD statement if you are using DSN1COPY to check or dump a page. The table spaces and index spaces must either be empty or defined with VSAM REUSE. STOGROUP-defined table spaces and index spaces have the REUSE attribute, except when you are applying the INCRCOPY option.

When you use the RESET option to reset page log RBAs, you need to ensure that the output data set for the RESET operation has the same name as the original DB2 data set. Use either of the following techniques to do that:
- Method 1:
  1. Make a backup copy of your original DB2 data set by using DSN1COPY to copy the original data set to a sequential data set.
  2. If you defined your original DB2 data set without the REUSE parameter, delete and redefine the original data set.
  3. Run DSN1COPY with the RESET option. Specify the output data set from step 1 as the input data set for the RESET operation.

     Use your original DB2 data set or the redefined version of the original data set as the output data set for the RESET operation.
- Method 2:
  1. Run DSN1COPY with the RESET option. Use your original DB2 data set as the input data set. Define a new VSAM data set as the output data set. The output data set must have the same data set characteristics as the input data set.
  2. Delete the input data set from step 1.

3. Rename the output data set from step 1 to the same name as the input data set.

Adding additional volumes for SYSUT2

When you create a table space or index space by using STOGROUP, the ICF catalog entry has only one volume in the volume list. If the SYSUT2 data set that DSN1COPY restores requires more than one volume, use the IDCAMS command, ALTER ADDVOLUMES, to add additional volume IDs to the integrated catalog entry. The extension to new volumes uses the primary size on each new volume. This is the normal VSAM extension process. If you want the data set to use the secondary size on the candidate volumes, follow these steps:

1. Run DSN1COPY.
2. Run REORG, or make a full image copy and recover the table space.

Performing these steps resets the data set and causes normal extensions through DB2.

Inconsistent data checks

When critical data is involved, use the CHECK option of DSN1COPY to prevent the undetected copying of inconsistent data to the output data set. The CHECK option performs validity checking on one page at a time.

You must run a CHECK utility job on the table space that is involved to ensure that no inconsistencies exist between data and indexes on that data:

- Before using DSN1COPY to save critical data that is indexed
- After using DSN1COPY to restore critical data that is indexed

The CHECK utility performs validity checking between pages.

The effects of not specifying the OBIDXLAT option

If you use DSN1COPY to load data into a table space or index without specifying the OBIDXLAT option, be careful not to invalidate embedded DB2 internal identifiers.

Those OBIDs can become invalid in the following circumstances:

- When you drop and re-create tables after the input data set to DSN1COPY was created.
- When a difference exists among the following attributes between the target subsystem and the source subsystem:
  - Table space attributes of BUFFERPOOL or NUMPARTS
  - Table attributes other than table name, table space name, and database name
  - The order of the table spaces, indexes, and tables that the user defined or dropped in the source and target databases

To protect against invalidating the OBIDs, specify the OBIDXLAT parameter for DSN1COPY. The OBIDXLAT parameter translates OBID, DBID, PSID, or ISOBID before DSN1COPY copies the data.

Requirements for using an image copy as input to DSN1COPY

To use image copies (full sequential or incremental) as input to DSN1COPY, you must use the COPY utility with SHRLEVEL REFERENCE to produce those image copies.

Using the FULLCOPY parameter ensures that the data that is contained in your image copies is consistent. DSN1COPY accepts an index image copy as input when you specify the FULLCOPY option. If you want to use inline image copies as input to DSN1COPY, you must produce those image copies by using the REORG utility or LOAD utility.

If you want to use a FlashCopy image copy data set as input, do not specify the FULLCOPY option.

Copying from an image copy

You can use DSN1COPY to copy data from an image copy of the data sets of a table space to the data sets of a table space on the same subsystem or another subsystem.

Procedure

To copy from a specific image copy data set, specify the following SYSUT2 data sets:

- **If SYSUT1 is an image copy of a single partition,** ensure that the SYSUT2 DD statement refers to the first data set of the table space. DSN1COPY determines the correct target data set. Code the NUMPARTS(*nn*) parameter, where *nn* is the number of partitions in the entire table space. However, if the partitioned table space is defined with more than one VCAT name (for example, a unique VCAT for different partitions), use SYSUT2 as the name of the data set for that partition.
- **If SYSUT1 is an image copy of an entire partitioned table space,** ensure that the SYSUT2 DD statement refers to the first data set of the table space. In this case, DSN1COPY allocates all of the target data sets. However, you must have previously defined the target data sets either by creating the partitioned table space with DEFINE YES or by using Access Method Services. Code the NUMPARTS parameter as described in the first bullet when the table space is partitioned. When multiple VCAT names are used for different partitions of a partitioned table space, DSN1COPY cannot restore the entire table space by using as input a single full image copy of the table space. In this case, when you use DSN1COPY, you must restore individual copies of each partition by using the name of the data sets for that partition. Code the NUMPARTS(*nn*) parameter, where *nn* is the number of partitions in the entire table space.
- **If SYSUT1 is an image copy of a single data set of a multiple data set nonpartitioned table space,** ensure that the SYSUT2 DD statement refers to the actual (not the first) output data set of the table space. Do not specify NUMPARTS because this parameter is only for partitioned table spaces.
- **If SYSUT1 is an image copy of an entire multiple data set nonpartitioned table space,** ensure that the SYSUT2 DD statement refers to the first data set of the table space. DSN1COPY allocates all target data sets. However, you must have previously defined the target data sets by using Access Method Services. If the source data sets are less than the target data sets it is recommended to either delete all rows from the target table space or to do a LOAD REPLACE with DD DUMMY on the target table space first, before running DSN1COPY.

- **If SYSUT1 is an image copy of a single data set of a multiple data set LOB table space,** ensure that the SYSUT2 DD statement refers to the actual (not the first) data set of the table space. Do not specify NUMPARTS because this parameter is only for partitioned table spaces.
- **If SYSUT1 is an image copy of an entire multiple data set LOB table space,** ensure that the SYSUT2 DD statement refers to the first data set of the table space. DSN1COPY allocates all target data sets. However, you must have previously defined the target data sets by using Access Method Services.

What to do next

Important: After you use DSN1COPY to copy data from an image copy, you need to ensure that the version information in the source and target table spaces matches. To do that, run REPAIR CATALOG on the target table space immediately after you run DSN1COPY.

Related tasks:

"Copying tables from one subsystem to another" on page 972

Restoring indexes with DSN1COPY

When a table space is restored using either the TOCOPY option of RECOVER or the DSN1COPY utility, restore the indexes.

Procedure

To restore indexes with DSN1COPY, use one of the following methods:

- Use the RECOVER utility, if you have a full image copy available, and the index was defined with the COPY YES option.
- Use DSN1COPY on the indexes, if a copy is available. If you specified the OBIDXLAT option for the data, you must also specify the OBIDXLAT option for the indexes. Also, the indexes must all have been copied at the same time as the data; otherwise, inconsistencies might exist.
- If you do not have an image copy of the index, use the REBUILD INDEX utility, which reconstructs the indexes from the data.

Related concepts:

"The effects of not specifying the OBIDXLAT option" on page 968

Related reference:

Chapter 26, "REBUILD INDEX," on page 427

Chapter 27, "RECOVER," on page 457

Restoring table spaces with DSN1COPY

In certain cases, you cannot use the RECOVER utility for an image copy data set. In these cases, consider using the DSN1COPY utility to restore the table space or data set instead.

About this task

You cannot use RECOVER TOCOPY for an image copy data set that is not referenced by SYSIBM.SYSCOPY for that table space or data set. An attempt to do so results in message DSNU519I `"TOCOPY DATASET NOT FOUND"`. The MODIFY utility might have removed the row in SYSIBM.SYSCOPY. If the row was removed and

the image copy is a full image copy with SHRLEVEL REFERENCE, use DSN1COPY to restore the table space or data set.

Restriction: If you use DSN1COPY for point-in-time recovery, the table space is not recoverable with the RECOVER utility. Because DSN1COPY runs outside of the control of DB2, DB2 is not aware that you recovered to a point in time. If possible, use DSN1COPY to recover the affected table space after a point-in-time recovery. Then perform the following steps:

1. Remove old image copies by using the MODIFY RECOVERY utility with the AGE option.
2. Create one or more full image copies by using the COPY utility with the SHRLEVEL REFERENCE option.

Procedure

To restore table spaces with DSN1COPY:

1. Delete data in any excess partitions from the table space before you apply the DSN1COPY utility.

   You can use the DSN1COPY utility to restore a partition or an entire table space for a partition-by-growth table space. The total number of partitions in the DSN1COPY input data set might not be consistent with the number of partitions that are defined on the current table space. To avoid residual data, delete data in the excess partitions from the table space before you apply the DSN1COPY utility.
2. If the table space is organized by hash, ensure that the following values are the same in the source and target tables spaces:
   - SYSTABLESPACE.HASHDATAPAGES (IF PBG)
   - SYSTABLEPART.HASHDATAPAGES (IF PBR-UTS)
3. If you are restoring an XML table space by using a data set that was generated by DSN1COPY before Version 10 new-function mode, complete the following steps before you run DSN1COPY:
   a. Alter the target XML table space so that the SEGSIZE value matches the SEGSIZE value of the original XML table space. Use the following statement:

      ```
      ALTER TABLESPACE mytablespace SEGSIZE 4
      ```

   b. Run the REORG TABLESPACE utility on the target XML table space.
4. Run the DSN1COPY utility. Make sure that you provide the correct sequence of image copies to DSN1COPY.

   DSN1COPY can restore the object to an incremental image copy, but it must first restore the previous full image copy and any intermediate incremental image copies. These actions ensure data integrity. You are responsible for providing the correct sequence of image copies. DB2 cannot ensure the appropriate sequence.
5. Ensure that the associated indexes are also rebuilt or restored. This action applies to all user-defined indexes and all indexes that are generated by DB2. For example, this action applies to the document ID index of a table with XML columns or the overflow index of a hash access table space.

Related reference:

"Syntax and options of the DSN1COPY control statement" on page 956

Chapter 22, "MODIFY RECOVERY," on page 385

"Syntax and options of the COPY control statement" on page 141

"Syntax and options of the REORG TABLESPACE control statement" on page 555

SYSIBM.SYSCOPY table (DB2 SQL)

SYSIBM.SYSTABLESPACE table (DB2 SQL)

SYSIBM.SYSTABLEPART table (DB2 SQL)

ALTER TABLESPACE (DB2 SQL)

Related information:

DSNU519I (DB2 Messages)

Printing with DSN1COPY

If you want to print one or more pages without invoking the utility's copy function, use DSN1PRNT to avoid unnecessary reading of the input file.

About this task

When you use DSN1COPY for printing, you must specify the PRINT parameter. The requested operation takes place only for the specified data set. If the input data set belongs to a nonpartitioned table space or index space that is larger than 2 GB, specify the correct data set. Alternatively, if it is a partitioned table space or partitioned index, specify the correct data set. For example, DSN1COPY prints a page range in the second partition of a four-partition table space. DSN1COPY does this by specifying NUMPARTS(4) and the data set name of the second data set in the VSAM group (DSN=...A002).

To print a full image copy data set (rather than recovering a table space), specify a DUMMY SYSUT2 DD statement, and specify the FULLCOPY parameter.

Copying tables from one subsystem to another

You can copy tables from one subsystem to another by using the DSN1COPY utility. When you copy these tables, ensure that the object metadata on the target subsystem matches the object metadata on the source subsystem. Object metadata includes items such as the number of columns, column type, table space type, and version information.

About this task

Recommendation: Do not use DSN1COPY to copy XML table spaces from one subsystem to another. Documents in XML table spaces have dependencies on DB2 catalog tables and on tables in the XML schema repository database (DSNXSR). In particular, XML documents in XML table spaces have unique strings IDs that must match values in catalog table SYSIBM.SYSXMLSTRINGS. Documents might also have XSR object IDs that must match values in XML schema repository table SYSIBM.XSROBJECTS. If you copy XML table spaces to from one subsystem to another, the string IDs and XSR object IDs in the XML documents will not match the values in SYSIBM.SYSXMLSTRINGS or SYSIBM.XSROBJECTS on the target subsystem.

Procedure

To copy a table space and table from one subsystem to another:

1. If a table space or table does not exist on the target subsystem, create it.
   If a table has an identity column, specify that column as follows:

a. Issue a SELECT statement on the source subsystem to query the SYSIBM.SYSSEQUENCES entry that corresponds to the identity column for the table on the source subsystem.
b. Add the INCREMENT value to the MAXASSIGNEDVAL value to determine the next value (*nv*) for the identity column.
c. For the table on the target subsystem, specify *nv* for the START WITH value.
d. Make all of the attributes for the identity column on the target table the same as the identity column attributes for the source table.

2. If the table space or table exists on the target subsystem, examine the table space, table, and column definitions in the catalog to ensure that the definitions are the same on the source and target subsystems.
3. If the table has been altered since its creation and has never been reorganized, take one of the following actions:
   - Run the REORG utility on the table space.

     You can determine if an object has been altered but not reorganized by checking the values of the OLDEST_VERSION and CURRENT_VERSION columns in SYSIBM.SYSTABLESPACE. If OLDEST_VERSION is 0 and CURRENT_VERSION is greater than 0, run REORG.
   - Do an INSERT or UPDATE after the last ALTER, to force the creation of a system page.
4. Ensure that enough version numbers are available. The combined active number of versions for the object on both the source and target subsystems must be less than 255. Use the following guidelines to calculate the active number of versions for the object on both the source and target subsystems:
   - If the value in the CURRENT_VERSION column is less than the value in the OLDEST_VERSION column, add the maximum number of versions to the value in the CURRENT_VERSION column.
   - Use the following formula to calculate the number of active versions:

     ```
     number of active_versions =
     MAX(target.CURRENT_VERSION,source.CURRENT_VERSION)
     - MIN(target.OLDEST_VERSION,source.OLDEST_VERSION) + 1
     ```

   If the number of active versions is too high, you must reduce the number of active versions by running REORG on both the source and target objects. Then, use the COPY utility to take a copy, and invoke the MODIFY RECOVERY utility to recycle the version numbers.
5. Query the DBID, PSID, and OBID of the object in the target subsystem. If the values are not the same as the source object, specify the DBID, PSID, and OBID as part of the OBIDXLAT data set for DSN1COPY.
6. Stop the table space on the source and target subsystems.
7. Run the DSN1COPY utility with the OBIDXLAT option. On the control statement, specify the proper mapping of table database object identifiers (OBIDs) for the table space from the source to the target subsystem.
8. Start the table space on the source and target subsystems for read/write access.
9. Run REPAIR CATALOG on the table space on the target subsystem to fix the catalog information. Alternatively, you can run REPAIR CATALOG TEST to check for any data and catalog inconsistencies but not correct them.

   REPAIR CATALOG updates the following columns:
   - OLDEST_VERSION in SYSTABLEPART
   - VERSION in SYSTABLES
   - OLDEST_VERSION and CURRENT_VERSION in SYSTABLESPACE

10. If there are any indexes that are defined on the table on the source subsystem, but are not defined on the table on the target subsystem, create those indexes.
11. Run REBUILD INDEX on all indexes that are defined on the table on the target subsystem.

Related reference:

"Syntax and options of the REPAIR control statement" on page 664

"Data sets that DSN1COPY uses" on page 963

"Syntax and options of the REBUILD INDEX control statement" on page 428

CREATE INDEX (DB2 SQL)

Sample DSN1COPY control statements

Use the sample control statements as models for developing your own DSN1COPY control statements.

If you run online REORG with FASTSWITCH behavior, the fifth-level qualifier in the data set name can be either I0001 or J0001. For clone tables, the data set can also be I0002 or J0002. These examples use I0001.

Example 1: Checking input data set before copying

The following statement specifies that the DSN1COPY utility is to copy the data set that is identified by the SYSUT1 DD statement to the data set that is identified by the SYSUT2 DD statement. Before DSN1COPY copies this data, the utility is to check the validity of the input data set.

```
//RUNCOPY EXEC PGM=DSN1COPY,PARM='CHECK'
//* COPY VSAM TO SEQUENTIAL AND CHECK PAGES
//STEPLIB  DD DSN=PDS CONTAINING DSN1COPY
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DSN=DSNCAT.DSNDBC.DSNDB01.SYSUTILX.I0001.A001,DISP=OLD
//SYSUT2   DD DSN=TAPE.DS,UNIT=TAPE,DISP=(NEW,KEEP),VOL=SER=UTLBAK
```

Example 2: Translating the DB2 internal identifiers

The statement in this example specifies that DSN1COPY is to copy the data set that is identified by the SYSUT1 DD statement to the data set that is identified by the SYSUT2 DD statement. The OBIDXLAT option specifies that DSN1COPY is to translate the OBIDs before the data set is copied. The OBIDs are provided as input on the SYSXLAT DD statement. Because the OBIDXLAT option is specified, DSN1COPY also checks the validity of the input data set, even though the CHECK option is not specified.

```
//EXECUTE EXEC PGM=DSN1COPY,PARM='OBIDXLAT'
//STEPLIB  DD  DSN=PDS CONTAINING DSN1COPY
//SYSPRINT DD  SYSOUT=A
//SYSUT1   DD  DSN=DSNC110.DSNDBC.DSN8D11P.DSN8S11C.I0001.A001,
//             DISP=OLD
//SYSUT2   DD  DSN=DSNC910.DSNDBC.DSN8D11P.DSN8S11C.I0001.A001,
//             DISP=OLD
//SYSXLAT  DD  *
260,280
2,10
3,55
6,56
7,57
/*
```

Figure 128. Example DSN1COPY statement with the OBIDXLAT option.

Example 3: Printing a single page of a partitioned table space

The following statement specifies that DSN1COPY is to print page 2002A1 of the table space in the data set that is identified by the SYSUT1 DD statement. This table space has eight partitions, as indicated by the NUMPARTS option.

```
//PRINT EXEC PGM=DSN1COPY,PARM='PRINT(2002A1),NUMPARTS(8)'
//* PRINT A PAGE IN THE THIRD PARTITION OF A TABLE SPACE CONSISTING
//* OF 8 PARTITIONS.
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT2   DD DUMMY
//SYSUT1   DD DSN=DSNCAT.DSNDBD.MMRDB.PARTEMP1.I0001.A003,DISP=OLD
```

Example 4: Printing 16 pages of a nonpartitioning index

The following statement specifies that DSN1COPY is to print 16 pages of a nonpartitioning index in the data set that is identified by the SYSUT1 DD statement. The pages range from page F0000 to page F000F, as indicated by the PRINT option. The maximum data set size is 64 MB, as indicated by the PIECESIZ option.

```
//PRINT2 EXEC PGM=DSN1COPY,PARM=(PRINT(F0000,F000F),PIECESIZ(64M))
//* PRINT THE FIRST 16 PAGES IN THE 61ST PIECE OF AN NPI WITH PIECE SIZE OF 64M
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT2    DD DUMMY
//SYSUT1    DD DISP=OLD,DSN=DSNCAT.DSTDBD.MMRDB.NPI1.I0001.A061
```

Example 5: Copying individual partitions of a partitioned table space

In the example in the following figure, the two job steps specify that DSN1COPY is to copy partitions 1501 and partition 1502 from image copy data sets into a partitioned table space. In the two SYSUT2 DD statements, the fifth-level qualifier in the data set names can differ, because each job step lists an individual partition. The FULLCOPY option is used in both steps to indicate that the input data set is a full image copy. The NUMPARTS option indicates that the input data set has 1600 partitions. The RESET option resets to 0 the high-formatted page number in the header page. Because this option is specified, DSN1COPY checks the validity of the input data, even though the CHECK option is not specified.

```
//STEP1    EXEC PGM=DSN1COPY,
//            PARM='NUMPARTS(1600),RESET,FULLCOPY'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DISP=SHR,DSN=PROD.IMAGE.COPY.PART1501
//SYSUT2   DD DISP=OLD,DSN=DSNCAT.DSNDBD.TESTDB.TS01.I0001.B501
//STEP2    EXEC PGM=DSN1COPY,
//            PARM='NUMPARTS(1600),RESET,FULLCOPY'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DISP=SHR,DSN=PROD.IMAGE.COPY.PART1502
//SYSUT2   DD DISP=OLD,DSN=DSNCAT.DSNDBD.TESTDB.TS01.J0001.B502
```

Figure 129. Example DSN1COPY job for partitions

Example 6: Copying all partitions of a partitioned table space

The following statement specifies that DSN1COPY is to copy data into all partitions of a partitioned table space by using a full image copy of the table space as input. The input image copy has 16 partitions, as indicated by the NUMPARTS option. You must ensure that the fifth-level qualifier in the data set name is the same, either I0001 or J0001, for **all** partitions of the output table space before running this type of job stream.

```
//DSN1COPY EXEC PGM=DSN1COPY,
//            PARM='NUMPARTS(16),RESET,FULLCOPY'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DISP=SHR,DSN=PROD.IMAGE.COPY.DSNUMALL
//SYSUT2   DD DISP=OLD,DSN=DSNCAT.DSNDBD.TESTDB.TS01.I0001.A001
```

Example 7: Using DSN1COPY with UTS table spaces

The following statements specify that DSN1COPY is to copy a UTS table space vsam data set to a sequential data set.

```
//*****************************************************************
//* COMMENT: RUN DSN1COPY FOR THE TABLESPACE Part 1
//*****************************************************************
//STEP1 EXEC PGM=DSN1COPY,
// PARM='SEGMENT,RESET'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSOUT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1 DD DSN=DSNCAT.DSNDBD.DBKQBG01.TPKQBG01.I0001.A001,DISP=SHR
//SYSUT2 DD DSN=JUKQU2BG.DSN1COPY.D1P1,DISP=(NEW,CATLG,CATLG),
// VOL=SER=SCR03,UNIT=SYSDA,SPACE=(TRK,(55,1))
/*
//*****************************************************************
//* COMMENT: RUN DSN1COPY FOR THE TABLESPACE Part 2
//*****************************************************************
//STEP2 EXEC PGM=DSN1COPY,
// PARM='SEGMENT,RESET'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSOUT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1 DD DSN=DSNCAT.DSNDBD.DBKQBG01.TPKQBG01.I0001.A002,DISP=SHR
//SYSUT2 DD DSN=JUKQU2BG.DSN1COPY.D1P2,DISP=(NEW,CATLG,CATLG),
// VOL=SER=SCR03,UNIT=SYSDA,SPACE=(TRK,(55,1))
/*
```

Example 8: Specifying Unicode output for DSN1COPY

When you specify the UNICODE option for DSN1COPY, you are not going to see non-Latin Unicode characters, such as Japanese characters, in your output. When you specify the UNICODE option, DSN1COPY takes the hexadecimal data and formats it as ASCII instead of the default EBCDIC.

A problem might arise when the data that you want DSN1COPY to handle is in UTF-16. In the case of UTF-16 data, DSN1COPY takes only the second byte of the data and formats that part of the data as ASCII. Thus, the output might not be correct. For example, the UTF-16 hexadecimal values X'0030' and X'1130' are both output as 0, because the first byte of each ("00" and "11" respectively) is ignored. The remaining part ("30") is interpreted as an ASCII 0. In UTF-16, X'0030' is the hexadecimal value for 0, but X'1130' is the hexadecimal value for a Hangul character. For more information about UTF-16 format, see UTFs (DB2 Internationalization Guide).

In the following DSN1COPY example, notice the three bold hexadecimal values: X'0041', X'0141', and X'0241'. The output for all three of these values is A.A.A, even though they each correspond to different characters in UTF-16. (X'0041' is A, X'0141' is ⌂, and X'0241' is the Latin capital character for glottal stop.)

```
//STEP1    EXEC PGM=DSN1COPY,
//         PARM='CHECK,PRINT(002),UNICODE'
//STEPLIB  DD DSN=DB2A.DSNLOAD,DISP=SHR
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSOUT   DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=TESTCAT.DSNDBC.DBED2101.TPED2101.I0001.A001,DISP=SHR
//SYSUT2   DD DSN=DUMMY
/*
DSN1999I START OF DSN1COPY FOR JOB RUNCPYI1 RUNCPYI1
DSN1989I DSN1COPY IS PROCESSED WITH THE FOLLOWING OPTIONS:
CHECK/   PRINT/ 4K/NO IMAGECOPY/NON-SEGMENT/NUMPARTS=   0/NO OBIDXLAT/NO VALUE/NO RESET/  /   /   /
DSSIZE=   /PIECESIZ=    /UNICODE/
DSN1998I INPUT  DSNAME = TESTCAT.DSNDBC.DBED2101.TPED2101.I0001.A001 , VSAM
DSN1997I OUTPUT DSNAME = NULLFILE                                     , SEQ
```

Contents of the input data set in hexadecimal:

```
0000 10000075 8C945500 00000200 0FC90033   00000101 02001F00 03018000 00010000
0020 41014102 41002000 20002000 20002000   20002000 00000000 00000000 00000000
.... LINES ARE ALL ZERO.
0FE0 00000000 00000000 00000000 00000000   00000000 00000000 00000000 001400D5
```

Contents of the input data set in ASCII:

```
*...u..U........3................*
*A.A.A. . . . . . . .............*
.... LINES ARE ALL ZERO.
*................................*
```

Example 9: Defining output data sets for multi-piece nonpartitioned table spaces

The following statements specify that DSN1COPY is to copy data into all pieces of a segmented table space by using a full image copy of another segmented table space as input.

1. Create the target segmented table space by specifying appropriate primary and secondary quantities.

2. Define data sets for all subsequent pieces.

   In the following example, the data set for the second piece is 'DSNCAT.DSNDBC.TESTDB.TS01.I0001.A002'. Use the MODEL option, which causes the new data set to be created like the first data set.

```
//ALCVSAM  EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
  DEFINE CLUSTER +
    (NAME('DSNCAT.DSNDBC.TESTDB.TS01.I0001.A002') +
     MODEL('DSNCAT.DSNDBC.TESTDB.TS01.I0001.A001')) +
  DATA +
    (NAME('DSNCAT.DSNDBD.TESTDB.TS01.I0001.A002') +
     MODEL('DSNCAT.DSNDBD.TESTDB.TS01.I0001.A001'))
/*
```

3. Run DSN1COPY.

```
//DSN1COPY EXEC PGM=DSN1COPY,
// PARM='FULLCOPY'
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD DISP=SHR,DSN=PROD.IMAGE.COPY.DSNUMALL
//SYSUT2 DD DISP=OLD,DSN=DSNCAT.DSNDBD.TESTDB.TS01.I0001.A001
```

Chapter 45. DSN1LOGP

The DSN1LOGP stand-alone utility formats the contents of the recovery log for display.

The two recovery log report formats are:

- A detail report of individual log records. This information helps IBM Software Support personnel analyze the log in detail. (This information does not include a full description of the detail report.)
- A summary report, which helps you:
  - Perform a conditional restart
  - Resolve indoubt threads with a remote site
  - Detect problems with data propagation

You can specify the range of the log to process and select criteria within the range to limit the records in the detail report. For example, you can specify:

- One or more units of recovery that are identified by URID
- A single database

By specifying a URID and a database, you can display recovery log records that correspond to the use of one database by a single unit of recovery.

DSN1LOGP can print the log records for both base and clone table objects.

DSN1LOGP cannot read logs that have been compressed by DFSMS. (This compression requires extended format data sets.)

Environment

DSN1LOGP runs as a batch z/OS job.

DSN1LOGP runs on archive data sets, but not active data sets, when DB2 is running.

Output

In all migration modes, formatted RBA and LRSN values are displayed in 10-byte format. The 10-byte formatted display is unrelated to migration of the catalog or directory, conversion of individual objects to EXTENDED format, or BSDS conversion. Dump format data, which might contain RBA or LRSN values, might show the 6-byte format of an RBA or LRSN in those cases where the value is displayed in the format in which it is stored. The format of the display represents the actual data at the time of the utility run, and is shown without conversion.

For recovery purposes, the 10-byte format is the preferred input format for DB2. When 10-byte RBA or LRSN values are specified as input to DB2, conversion to 6-byte format is performed internally as needed.

Even before the BSDS is converted to Version 11 format on all data sharing members or the catalog and directory are migrated, 10-byte LRSN values might be displayed with non-zero digits in the low order 3 bytes. LRSN values captured before the BSDS is converted continue to be displayed as they were saved until

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they are no longer available for display (for example, deleted by MODIFY RECOVERY). This behavior is normal and to be expected, given the many ways LRSN values are generated, stored, and handled in DB2. If these LRSN values are specified as input to DB2, specify them as shown. If the LRSN value contains non-zero digits in the low order 3 bytes, do not remove them. Any conversion that might be required takes place inside DB2.

Authorization required

DSN1LOGP does not require authorization. However, if any of the data sets is RACF-protected, the authorization ID of the job must have RACF authority.

Required data sets

When you execute DSN1LOGP, provide the following data definition (DD) statements:

SYSPRINT
DSN1LOGP writes all error messages, exception conditions, and the detail report to the SYSPRINT file. The logical record length (LRECL) is 131.

SYSIN
DSN1LOGP specifies keywords in this file. The LRECL must be 80. Keywords and values must appear in characters 1 through 72. DSN1LOGP allows specification of as many as 50 control statements for a given job. DSN1LOGP concatenates all records into a single string.

SYSSUMRY
DSN1LOGP writes the formatted output of a summary report to the SYSSUMRY file. The LRECL is 131.

DSN1LOGP identifies the recovery log by DD statements that are described in the stand-alone log services.

Identifying log data sets

You must identify to DSN1LOGP the log data sets that are to be processed by including at least one of the following DD statements.

BSDS The BSDS identifies and provides information about all active log data sets and archive log data sets that exist in your DB2 subsystem. When you identify the BSDS to DSN1LOGP, you must provide the beginning and ending RBAs for the range of the recovery log that you want displayed. DSN1LOGP then associates the beginning RBA specifications and the ending RBA specifications with the appropriate data set names.

ACTIVE*n*
If the BSDS is not available, and if the active log data sets that are involved were copied and sent to you, use ACTIVE DD statements. Use one or more ACTIVE DD statements to specify the set of active log data sets that are to be processed by DSN1LOGP. If you used the REPRO command of Access Method Services for copying the active log, you must identify this data set in an ARCHIVE DD statement.

Each DD statement that you include identifies another active log data set. If you identify more than one active log data set, you must list the ACTIVE*n* DD statements in ascending log RBA sequence. For example, ACTIVE1 must identify a portion of the log that is less than ACTIVE2, and ACTIVE2 must identify a portion of the log that is less than ACTIVE3. If

you do not specify these DD statements correctly, errors that DSN1LOGP does not detect can occur. You can specify up to 16 of these active log data sets.

When you identify active log data sets, you do not need to use the RBASTART and RBAEND keywords (as you do when you identify the BSDS). DSN1LOGP scans all active log data sets that the job indicates only when the data sets are in the correct log RBA sequence.

ARCHIVE
If the BSDS is not available (as previously described under ACTIVE*n*), you can specify which archive log data sets are to be processed by specifying one ARCHIVE DD statement, concatenated with one or more DD statements.

Each DD statement that you include identifies another archive log data set. If you identify more than one archive log data set, you must list the DD statements that correspond to the multiple archive log data sets in ascending log RBA sequence. If you do not specify this correctly, errors that DSN1LOGP does not detect can occur.

When you identify archive log data sets, you do not need to use the RBASTART and RBAEND keywords. DSN1LOGP scans all archive log data sets that are indicated by the job only when the data sets are in the correct log RBA sequence.

Data sharing requirements

When selecting log records from more than one DB2 subsystem, you must use all or one of the following DD statements to locate the log data sets:
GROUP
M*xx*BSDS
M*xx*ARCHV
M*xx*ACT*n*

If you use GROUP or M*xx*BSDSs to locate the log data sets, you must use LRSNSTART to define the selection range.

Related tasks:

Reading log records with OPEN, GET, and CLOSE (DB2 Administration Guide)

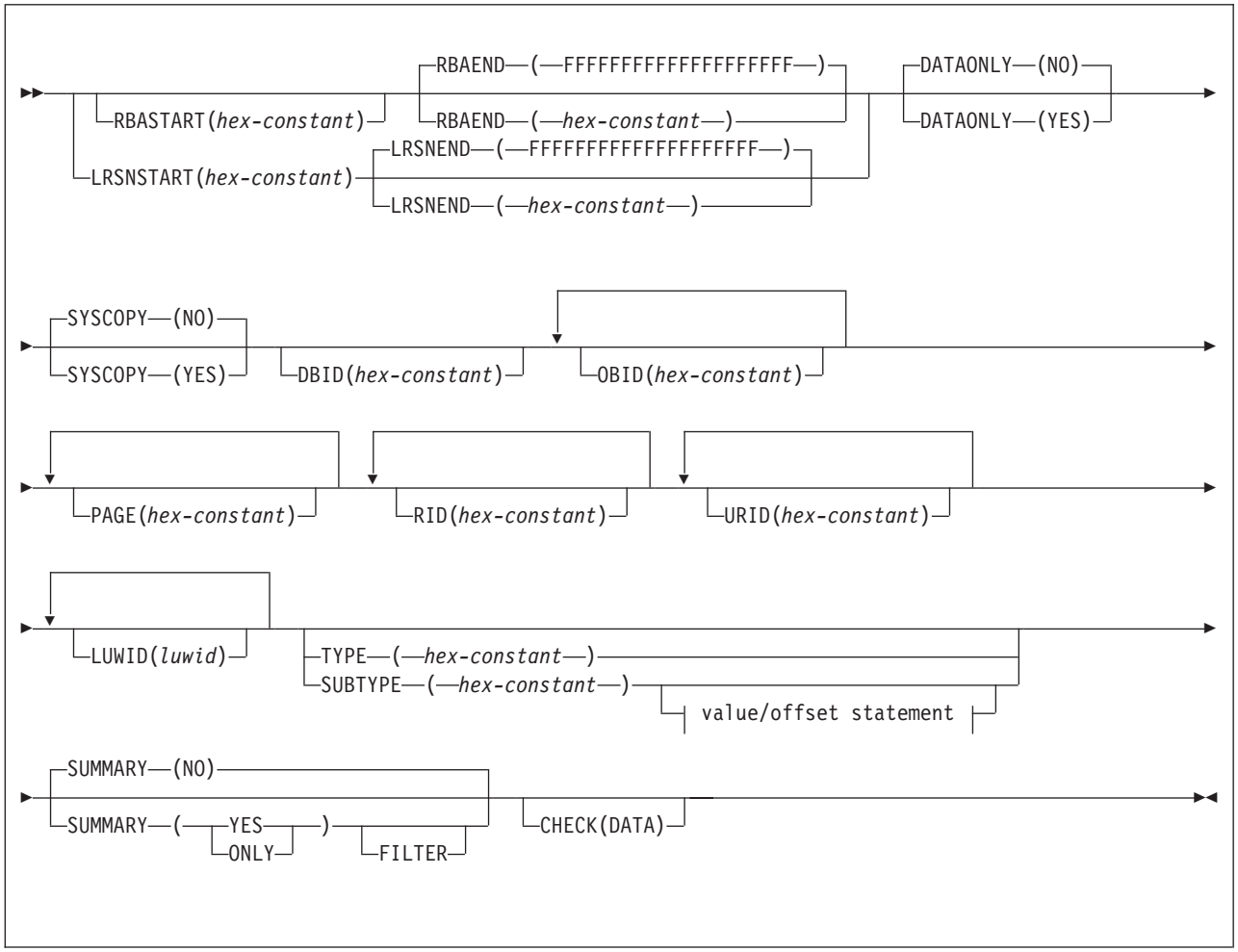
Related information:

DB2 Diagnosis Guide and Reference

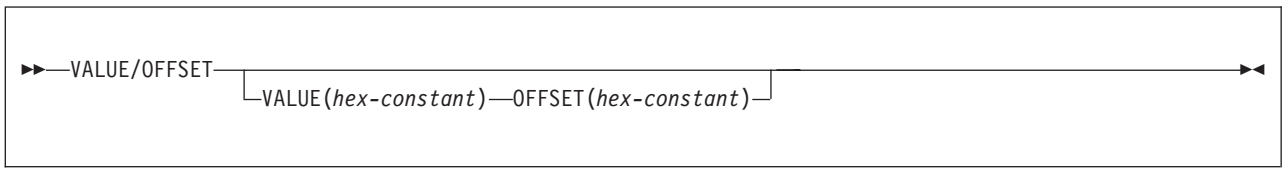
Syntax and options of the DSN1LOGP control statement

The DSN1LOGP utility control statement, with its multiple options, defines the function that the utility job performs.

DSN1LOGP syntax diagram



value/offset statement:



Option descriptions

To run DSN1LOGP, construct a batch job. Include the utility name, DSN1LOGP, on the EXEC statement.

Specify keywords in up to 50 control statements in the SYSIN file. Each control statement can have up to 72 characters. To specify no keywords, either use a SYSIN file with no keywords following it, or omit the SYSIN file from the job JCL.

If you specify more than one keyword, separate them by commas. You can specify the keywords in any order. You can include blanks between keywords, and also between the keywords and the corresponding values.

RBASTART(*hex-constant***)**
Specifies the hexadecimal log RBA from which to begin reading. If the value does not match the beginning RBA of one of the log records, DSN1LOGP begins reading at the beginning RBA of the next record. Specify this keyword only once in the job. Alternative spellings: STARTRBA, ST.

hex-constant is a hexadecimal value that consists of 1 - 12 characters (6 bytes) or 1 - 20 characters (10 bytes) if the BSDS was converted by using the DSNJCNVT conversion program. Leading zeros are not required.

The default value is **0**.

DB2 issues a warning if the value is not within the range of log records that is covered by the input log record information.

RBAEND(*hex-constant***)**
Specifies the last valid hexadecimal log RBA to extract. If the specified RBA is in the middle of a log record, DSN1LOGP continues reading the log in an attempt to return a complete log record.

To read to the last valid RBA in the log up to the point of the 6 byte maximum, specify RBAEND(FFFFFFFFFFFF). To read to the last valid RBA in the log, specify RBAEND(FFFFFFFFFFFFFFFFFFFF). Specify this keyword only once in the job. Alternative spellings: ENDRBA, EN.

hex-constant is a hexadecimal value that consists of 1 - 12 characters (6 bytes) or 1 - 20 characters (10 bytes) if the BSDS was converted by using the DSNJCNVT conversion program. Leading zeros are not required.

The default value is **FFFFFFFFFFFFFFFFFFFF**.

DB2 issues a warning if the value is not within the range of log records that is covered by the input log record information.

RBAEND can be specified only if RBASTART is specified.

LRSNSTART(*hex-constant***)**
Specifies the log record sequence number (LRSN) from which to begin the log scan. DSN1LOGP starts its processing on the first log record that contains an LRSN value that is greater than or equal to the LRSN value that is specified on LRSNSTART. The default LRSN is the LRSN at the beginning of the data set. Alternative spellings: STARTLRSN, STRTLRSN, and LRSNSTRT.

Specify this keyword only once in the job.

You must specify this keyword to search the member BSDSs and to locate the log data sets from more than one DB2 subsystem. You can specify either the LRSNSTART keyword or the RBASTART keyword to search the BSDS of a single DB2 subsystem and to locate the log data sets.

If you specify both LRSNSTART and LRSNEND, values greater than 12 characters must be the same length.

DB2 issues a warning if the value is not within the range of log records that is covered by the input log record information.

LRSNEND(*hex-constant***)**
Specifies the LRSN value of the last log record that is to be scanned if LRSNSTART is also specified. If LRSNEND is not specified, the LRSNEND value is either current end of the log (X'FFFFFFFFFFFFFFFFFFFF') or the LRSN value for the end of the data set.

DSN1LOGP ends its processing on the last log record that contains an LRSN value that is greater than or equal to the LRSN value that is specified on LRSNEND.

An alternative spelling for LRSNEND is ENDLRSN.

Specify this keyword only once in the job.

If you specify both LRSNSTART and LRSNEND, values greater than 12 characters must be the same length.

DB2 issues a warning if the value is not within the range of log records that is covered by the input log record information.

DATAONLY
Limits the log records in the detail report to those records that represent data changes (such as insert, page repair, and update space map).

The default value is **DATAONLY**(**NO**).

(YES)
Extracts log records for data changes only. For example, DATAONLY(YES), together with a DBID and OBID, reads only the log records that modified data for that DBID and OBID.

(NO)
Extracts all record types.

SYSCOPY
Limits the detail report to SYSCOPY log records.

The default value is **SYSCOPY**(**NO**).

(YES)
Includes only SYSCOPY log records in the detail report.

(NO)
Does not limit records to SYSCOPY records only.

DBID(*hex-constant***)**
Specifies a hexadecimal database identifier (DBID). DSN1LOGP extracts only the records that are associated with that DBID. Specify this keyword only once in the job.

hex-constant is a hexadecimal value that consists of one to 4 characters. Leading zeros are not required.

You can find the DBID in any of the following ways:

- The DBID is displayed in many DB2 messages.
- You can find the DBID in the DB2 catalog for a specific object (for example, in the column that is named DBID of the SYSIBM.SYSTABLESPACE catalog table).
- When you select a DBID from a catalog table, the value is displayed in decimal format. Use the SQL HEX function in a SELECT statement to convert a DBID to hexadecimal format. The following SQL statements show this use of the HEX function:

```
SELECT NAME, DBNAME, HEX(DBID), HEX(PSID)
FROM SYSIBM.SYSTABLESPACE
WHERE NAME ='table space name'

SELECT NAME, DBNAME, HEX(DBID), HEX(ISOBID)
FROM SYSIBM.SYSINDEXES
WHERE NAME ='index name'
```

- You can use the DSN1PRNT utility to format the data sets for tables or indexes, and find the DBID in first 2 bytes of HPGOBID.

OBID(*hex-constant***)**
Specifies a hexadecimal database object identifier, either a data page set identifier (PSID) or an index page set identifier (ISOBID). DSN1LOGP extracts only the records that are associated with that identifier.

hex-constant is a hexadecimal value that consists of one to 4 characters. Leading zeros are not required.

Whenever DB2 changes the data, the log record that describes the change identifies the database by DBID and the table space by page set ID (PSID). You can find the PSID column in the SYSIBM.SYSTABLESPACE catalog table.

You can also find a column that is named OBID in the SYSIBM.SYSTABLESPACE catalog table. That column contains the OBID of a file descriptor; do not confuse this value with the PSID, which is the information that you must include when you run DSN1LOGP.

Whenever DB2 changes an index, the log record that describes the change identifies the database (by DBID) and the index space (by index space OBID or ISOBID). You can find the ISOBID for an index space in the column that is named ISOBID in the SYSIBM.SYSINDEXES catalog table.

You can also find a column that is named OBID in the SYSIBM.SYSINDEXES catalog table. This column contains the identifier of a fan set descriptor; do not confuse this value with the ISOBID, which is the information that you must include when you run DSN1LOGP.

When you select either the PSID or the ISOBID from a catalog table, the value is displayed in decimal format. Use the SQL HEX function in your select statement to convert them to hexadecimal.

Alternatively, you can use the DSN1PRNT utility to format the data sets for tables or indexes, and find the PSID or ISOBID in the last 2 bytes of HPGOBID.

You can specify the OBID keyword up to 10 times for a single DSN1LOGP job. If you specify OBID, you must also specify DBID.

PAGE(*hex-constant***)**
Specifies a hexadecimal page number. When data or an index is changed, a recovery log record is written to the log, identifying the object identifier and the page number of the changed data page or index page. Specifying a page number limits the search to a single page; otherwise, all pages for the combination of DBID and OBID are extracted. The log output also contains page set control log records for the specified DBID and OBID, and system event log records, unless DATAONLY(YES) is also specified.

hex-constant is a hexadecimal value that consists of a maximum of 8 characters.

You can specify a maximum of 100 PAGE keywords in a single DSN1LOGP job. You must also specify the DBID and OBID keywords that correspond to those pages.

The PAGE and RID keywords are mutually exclusive.

RID(*hex-constant***)**
Specifies a record identifier, which is a hexadecimal value that consists of 10 characters, with the first 8 characters representing the page number and the last 2 characters representing the page ID map entry number. The option limits

the log records that are extracted to those records that are associated with that particular record. The log records that are extracted include the following records:

- Those records that are directly associated with the RID, such as insert and delete
- The control records that are associated with the DBID and OBID specifications, such as page set open, page set close, set write, reset write, page set write, data set open, and data set close

You can specify a maximum of 40 RID keywords in a single DSN1LOGP job. You must also specify the DBID and OBID keywords that correspond to the specified records.

The PAGE and RID keywords are mutually exclusive.

URID(*hex-constant***)**
Specifies a hexadecimal unit of recovery identifier (URID). Changes to data and indexes occur in the context of a DB2 unit of recovery, which is identified on the log by a BEGIN UR record. In the summary DSN1LOGP report, the URID is listed in the STARTRBA field in message DSN1162I. In the detail DSN1LOGP report, look for the subtype of BEGIN UR; the URID is listed in the URID field. Using the log RBA of that record as the URID value limits the extraction of information from the DB2 log to that unit of recovery.

hex-constant is a hexadecimal value that consists of 1 - 12 characters (6 bytes) or 1 - 20 characters (10 bytes) if the BSDS was converted by using the DSNJCNVT conversion program. Leading zeros are not required.

You can specify a maximum of 10 URID keywords in a single DSN1LOGP job.

LUWID(*luwid***)**
Specifies up to 10 LUWIDs that DSN1LOGP is to include information about in the summary report.

luwid consists of three parts: an LU network name, an LUW instance number, and a commit sequence number. If you supply the first two parts, the summary report includes an entry for each commit that is performed in the logical unit of work (within the search range). If you supply all three parts, the summary report includes an entry for only that LUWID.

The LU network name consists of a one- to eight-character network ID, a period, and a one- to eight-character network LU name. The LUW instance number consists of a period, followed by 12 hexadecimal characters. The last element of the LUWID is the commit sequence number of 4 hexadecimal characters, preceded by a period.

TYPE(*hex-constant***)**
Limits the log records that are extracted to records of a specified type. The TYPE and SUBTYPE options are mutually exclusive.

If you specify TYPE, DSN1LOGP ignores the values that you specify for the other keywords except for RBASTART, RBAEND, LRSNSTART, and LRSNEND.

hex-constant indicates the type, as follows:

Constant	Description
2	Page set control record
4	SYSCOPY utility record

10 System event record

20 UR control record

100 Checkpoint record

200 UR-UNDO record

400 UR-REDO record

800 Archive quiesce record

1000 - 8000
Assigned by the resource manager

SUBTYPE(*hex-constant***)**
Restricts formatting to a particular subtype of unit of recovery undo and redo log records (types 200 and 400). The TYPE and SUBTYPE options are mutually exclusive.

hex-constant indicates the subtype, as follows:

Constant
Description

1 Update data page

2 Format page or update space map

3 Update space map bits

4 Update to index space map

5 Update to index page

6 DBA table update log record

7 Checkpoint DBA table log record

9 DBD virtual memory copy

A Exclusive lock on page set partition or DBD

B Format file page set

C Format index page set

F Update by repair (first half if 32 KB)

10 Update by repair (second half if 32 KB)

11 Allocate or deallocate a segment entry

12 Undo/redo log record for modified page or redo log record for formatted page

14 Savepoint

15 Other DB2 component log records that are written for RMID 14

17 Checkpoint record of modified page set

19 Type 2 index update

1A Type 2 index undo/redo or redo log record

1B Type 2 index change notification log record

1C Type 2 index space map update

1D DBET log record with exception data

1E DBET log record with LPL/GRECP data

65 Change Data Capture diagnostic log

81 Index dummy compensation log record

82 START DATABASE ACCESS (FORCE) log record

The VALUE and OFFSET options must be used together. You can specify a maximum of 10 VALUE-OFFSET pairs. The SUBTYPE parameter is required when you specify the VALUE and OFFSET options.

VALUE(*hex-constant***)**
Specifies a value that must appear in a log record that is to be extracted.

hex-constant is a hexadecimal value that consists of a maximum of 64 characters and must be an even number of characters.

The SUBTYPE keyword must be specified before the VALUE option.

OFFSET(*hex-constant***)**
Specifies an offset from the log record header at which the value that is specified in the VALUE option must appear.

hex-constant is a hexadecimal value that consists of a maximum of 8 characters.

If you specify the OFFSET option, you must specify the SUBTYPE keyword.

SUMMARY
Summarizes all recovery information within the RBASTART and RBAEND specifications. You can use summary information to determine what work is incomplete when DB2 starts. You cannot limit the output of the summary report with any of the other options, except by using the FILTER option with a URID or LUWID specification.

The default value is **SUMMARY**(**NO**).

(YES)
Generates both a detail and summary report.

(NO)
Generates only a detail report.

(ONLY)
Generates only a summary report.

FILTER
Restricts the summary report to include messages for only the specified URIDs and LUWIDs. Specify this option only once.

The SUMMARY keyword must be specified before FILTER.

CHECK(DATA)
Specifies that DSN1LOGP is to check the specified range of data pages for page regression. Any page regression errors are displayed in the detail and summary reports.

Related concepts:

"DSN1LOGP output" on page 993

Related reference:

"Sample DSN1LOGP control statements" on page 990

Determining the PSID for base and clone objects

You can determine the PSID for base and clone objects by querying the SYSIBM.SYSTABLESPACE catalog table. You can specify the PSID on the DBID and OBID keywords of the DSN1LOGP utility control statement.

Procedure

To determine the PSID to specify for base or clone objects:

1. Determine the PSID by querying the SYSIBM.SYSTABLESPACE catalog table. The value is displayed in decimal format. Use the SQL HEX function in your select statement to convert the value to hexadecimal.
2. Determine the instance number of the clone or base object. You can determine the instance number in two ways:
   - Look at the TYPE column in the DISPLAY DATABASE command output. The output indicates the base and clone objects with a 'B' or a 'C' character respectively along with the data set instance number.
   - Look at the DB2 catalog. The SYSIBM.SYSTABLESPACE catalog table INSTANCE column indicates the current instance number of the base table.
3. Determine whether to alter the PSID value or leave the PSID value the same. For example, if the PSID value of the base or clone is '0009'X and the instance number is 1, specify a PSID value of '0009'X to DSN1LOGP. If the PSID of the base or clone is '0009'X and the instance number is 2, specify a PSID value of '8009'X to DSN1LOGP.

Related reference:

-DISPLAY DATABASE (DB2) (DB2 Commands)

SYSIBM.SYSTABLESPACE table (DB2 SQL)

Archive log data sets on tape

If you store your archive logs on tape, the offload task constructs two files on tape during the archiving process. The first file is the BSDS, and the second file is a dump of the active log that the offload task is currently archiving.

If a failure occurs during the time that the offload task is archiving the BSDS, DB2 might omit the BSDS. In this case, the first file contains the active log.

If you perform archiving on tape, the first letter of the lowest-level qualifier varies for both the first and second data sets. The first letter of the first data set is B (for BSDS), and the first letter of the second data set is A (for archive). Hence, the archive log data set names all end in A*xxxxxxx*, and the DD statement identifies each of them as the second data set on the corresponding tape:

```
LABEL=(2,SL)
```

When reading archive log data sets on tape (or copies of active log data sets on tape), add one or more of the following Job Entry Subsystem (JES) statements:

For the JES3 environment:

JES3 environment JCL
Description

//*MAIN SETUP=JOB
Alert the z/OS operator to mount the initial volumes before the job executes.

//*MAIN HOLD=YES
Place the job in HOLD status until the operator is ready to release the job.

TYPRUN=HOLD
Perform the same function as //*MAIN HOLD=YES. The system places the JCL on the JOB statement.

For the JES2 environment:

JES2 environment JCL
Description

/*SETUP
Alert the z/OS operator to prepare to mount a specified list of tapes.

/*HOLD
Place the job in HOLD status until the operator has located the tapes and is ready to release the job.

TYPRUN=HOLD
Perform the same function as /*HOLD. The system places the JCL on the JOB statement.

Alternatively, submit the job to a z/OS initiator that your operations center has established for exclusive use by jobs that require tape mounts. Specify the initiator class by using the CLASS parameter on the JOB statement, in both JES2 and JES3 environments.

Related reference:

MVS JCL Reference

Sample DSN1LOGP control statements

Use the sample control statements as models for developing your own DSN1LOGP control statements.

Example 1: Extracting information from the recovery log with an available BSDS

The following example shows how to extract information from the recovery log when you have the BSDS available. The extraction starts at the log RBA of X'00000FC000000000A000' and ends at the log RBA of X'00000FC000000000B000'. The DSN1LOGP utility identifies the table or index space by the DBID of X'10A' (266 decimal) and the OBID of X'1F' (31 decimal).

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB  DD DSN=PDS containing DSN1LOGP
//SYSPRINT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//BSDS     DD DSN=DSNCAT.BSDS01,DISP=SHR
//SYSIN    DD *
  RBASTART (00000FC000000000A000)
  RBAEND   (00000FC000000000B000)
  DBID (10A) OBID(1F)
/*
```

You can think of the DB2 recovery log as a large sequential file. When recovery log records are written, they are written to the end of the log. A log RBA is the address of a byte on the log. Because the recovery log is larger than a single data set, the recovery log is physically stored on many data sets. DB2 records the RBA ranges and their corresponding data sets in the BSDS. To determine which data set contains a specific RBA, read the information about the DSNJU004 utility. During normal DB2 operation, messages are issued that include information about log RBAs.

Example 2: Extracting information from the active log when the BSDS is not available

The following example shows how to extract the information from the active log when the BSDS is not available. The extraction includes log records that apply to the table space or index space that is identified by the DBID of X'10A' and the OBID of X'1F'. The only information that is extracted is information that relates to page numbers X'3B' and X'8C', as identified by the PAGE options. You can omit beginning and ending RBA values for ACTIVE*n* or ARCHIVE DD statements because the DSN1LOGP search includes all specified ACTIVE*n* DD statements. The DD statements ACTIVE1, ACTIVE2, and ACTIVE3 specify the log data sets in ascending log RBA range. Use the DSNJU004 utility to determine what the log RBA range is for each active log data set. If the BSDS is not available and you cannot determine the ascending log RBA order of the data sets, you must run each log data set individually.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB  DD DSN=PDS containing DSN1LOGP
//SYSPRINT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//ACTIVE1  DD DSN=DSNCAT.LOGCOPY1.DS02,DISP=SHR      RBA X'A000' - X'BFFF'
//ACTIVE2  DD DSN=DSNCAT.LOGCOPY1.DS03,DISP=SHR      RBA X'C000' - X'EFFF'
//ACTIVE3  DD DSN=DSNCAT.LOGCOPY1.DS01,DISP=SHR      RBA X'F000' - X'12FFF'
//SYSIN    DD *
  DBID (10A) OBID(1F) PAGE(3B) PAGE(8C)
/*
```

Example 3: Extracting information from the archive log when the BSDS is not available

The example in the following figure shows how to extract the information from archive logs when the BSDS is not available. The extraction includes log records that apply to a single unit of recovery (whose URID is X'61F321'). Because the BEGIN UR is the first record for the unit of recovery and is at X'61F321', the beginning RBA is specified to indicate that it is the first RBA in the range from which to extract recovery log records. Also, because no ending RBA value is specified, all specified archive logs are scanned for qualifying log records. The specification of DBID(4) limits the scan to changes that the specified unit of recovery made to all table spaces and index spaces in the database whose DBID is X'4'.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB  DD DSN=PDS containing DSN1LOGP
//SYSPRINT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//ARCHIVE  DD DSN=DSNCAT.ARCHLOG1.A0000037,UNIT=TAPE,VOL=SER=T10067,
//            DISP=(OLD,KEEP),LABEL=(2,SL)
//         DD DSN=DSNCAT.ARCHLOG1.A0000039,UNIT=TAPE,VOL=SER=T30897,
//            DISP=(OLD,KEEP),LABEL=(2,SL)
//         DD DSN=DSNCAT.ARCHLOG1.A0000041,UNIT=TAPE,VOL=SER=T06573,
//            DISP=(OLD,KEEP),LABEL=(2,SL)
//SYSIN    DD *
  RBASTART (61F321)
  URID (61F321) DBID(4)
/*
```

Figure 130. Example DSN1LOGP statement with RBASTART and URID options

Example 4: Use DSN1LOGP with the SUMMARY option

The DSN1LOGP SUMMARY option allows you to scan the recovery log to determine what work is incomplete at restart time. You can specify this option either by itself or when you use DSN1LOGP to produce a detail report of log data. Summary log results appear in SYSSUMRY; therefore, you must include a SYSSUMRY DD statement as part of the JCL with which you execute DSN1LOGP.

The following example produces both a detail and a summary report that uses the BSDS to identify the log data sets. The summary report summarizes all recovery log information within the RBASTART and RBAEND specifications. You cannot limit the output of the summary report with any of the other options, except by using the FILTER option with a URID or LUWID specification. RBASTART and RBAEND specification use depends on whether a BSDS is used.

This example is similar to Example 1, in that it shows how to extract the information from the recovery log when you have the BSDS available. However, this example also shows you how to specify a summary report of all logged information between the log RBA of X'AF000' and the log RBA of X'B3000'. This summary is generated with a detail report, but it is printed to SYSSUMRY separately.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB  DD DSN=PDS containing DSN1LOGP
//SYSPRINT DD SYSOUT=A
//SYSSUMRY DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//BSDS     DD DSN=DSNCAT.BSDS01,DISP=SHR
//SYSIN    DD *
  RBASTART (AF000) RBAEND (B3000)
  DBID (10A) OBID(1F) SUMMARY(YES)
/*
```

Example 5: Use DSN1LOGP on all members of a data sharing group

The following example shows how to extract log information that pertains to the table space that is identified by DBID X'112' and OBID X'1D' from all members of a data sharing group.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB DD  DSN=PDS containing DSN1LOGP
//SYSPRINT SYSOUT=A
//SYSABEND SYSOUT=A
//GROUP DD DSN=DSNDB0G.BSDS01,DISP=SHR
//SYSIN DD *
```

```
  DATAONLY (YES)
  LRSNSTART (00CA21F57927B1D48000)
  LRSNEND   (00CA21F57927B2BBB000)
  DBID (112) OBID(1D)
/*
```

Example 6: Use DSN1LOGP on a single member of a data sharing group

The following example shows how to extract log information that pertains to the table space that is identified by DBID X'112' and OBID X'1D' from a single member of a data sharing group.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB DD  DSN=PDS containing DSN1LOGP
//SYSPRINT SYSOUT=A
//SYSABEND SYSOUT=A
//M01BSDS DD DSN=DSNDB0G.DB1G.BSDS01,DISP=SHR
//SYSIN DD *
  DATAONLY (YES)
  LRSNSTART (A7951A001AD5) LRSNEND (A7951A003B6A)
  DBID (112) OBID(1D)
/*
```

Example 5: Use DSN1LOGP on all members of a data sharing group

The following example shows how to extract log information that pertains all log records matching DBID X'112' and OBID X'1D' from the data sharing group after the LRSN X'00CAFFFFFFFFF1D48000'.

```
//STEP1 EXEC PGM=DSN1LOGP
//STEPLIB DD  DSN=PDS containing DSN1LOGP
//SYSPRINT SYSOUT=A
//SYSABEND SYSOUT=A
//GROUP DD DSN=DSNDB0G.BSDS01,DISP=SHR
//SYSIN DD *
  DATAONLY (YES)
  LRSNSTART (00CAFFFFFFFFF1D48000)
  LRSNEND   (FFFFFFFFFFFFFFFFFFFF)
  DBID (112) OBID(1D)
/*
```

Related tasks:

Resetting the log RBA (DB2 Administration Guide)

Related reference:

Chapter 42, “DSNJU004 (print log map),” on page 923

DSN1LOGP output

One intended use of this utility is to aid in determining and correcting system problems. When diagnosing DB2 problems, you might need to refer to licensed documentation to interpret output from this utility.

Reviewing DSN1LOGP output

With the SUMMARY option, you can produce a summary report, a detail report, or both. You can also use the CHECK(DATA) option to produce a summary and detail report of page regression errors.

For data sharing, you might see multiple log records with the same LRSN value on a single DB2 data sharing member.

Description of the summary report

The summary report in the following figure contains a summary of completed events, consisting of an entry for each completed unit of work. Each entry shows, among other information, the start time, user, and all page sets that were modified. When possible, the report shows whether an object is LOGGED or NOT LOGGED.

The summary report is divided into two distinct sections:

- The first section is headed by the following message:
  `DSN1150I SUMMARY OF COMPLETED EVENTS`
- The second section is headed by the following message:
  `DSN1157I RESTART SUMMARY`

The first section lists all completed units of recovery (URs) and checkpoints within the range of the log that is scanned. Events are listed chronologically, with URs listed according to when they were completed and checkpoints listed according to when the end of the checkpoint was processed. The page sets that are changed by each completed UR are listed. If a log record that is associated with a UR is unavailable, the attribute INFO=PARTIAL is displayed for the UR. Otherwise, the UR is marked INFO=COMPLETE. A log record that is associated with a UR is unavailable if the range of the scanned log is not large enough to contain all records for a given UR.

The DISP attribute can be one of the following values: COMMITTED, ABORTED, INFLIGHT, IN-COMMIT, IN-ABORT, POSTPONED ABORT, or INDOUBT. The DISP attributes COMMITTED and ABORTED are used in the first section; the remaining attributes are used in the second section.

The list in the second section shows the work that is required of DB2 at restart as it is recorded in the log that you specified. If the log is available, the checkpoint that is to be used is identified, as is each outstanding UR, together with the page sets it changed. Each page set with pending writes is also identified, as is the earliest log record that is required to complete those writes. If a log record that is associated with a UR is unavailable, the attribute INFO=PARTIAL is displayed, and the identification of modified page sets is incomplete for that UR.

```
DSN1212I DSN1LGRD FIRST LOG LRSN ENCOUNTERED 00CA21F57927B1D48000

================================================================================
DSN1150I SUMMARY OF COMPLETED EVENTS

DSN1151I DSN1LPRT MEMBER=DB2A     UR  CONNID=DB2A      CORRID=021.OPNLGR00  AUTHID=SYSOPR    PLAN=SYSTEM
              START DATE=00.161 TIME=11:27:30  DISP=COMMITTED           INFO=COMPLETE
              STARTRBA=0000000000002BB36475   ENDRBA=0000000000002BB37024
              STARTLRSN=00CA21F57945B9AE2000  ENDLRSN=00CA21F57953A83EC000
              NID=* LUWID=DSNCAT.SYEC1DB2.CA21F5792E8A.0001
              COORDINATOR=* PARTICIPANTS=*
              DATA MODIFIED:
                   DATABASE=0001=DSNDB01   PAGE SET=00CF=SYSLGRNX
                   DATABASE=0001=DSNDB01   PAGE SET=0087=DSNLLX01
                   DATABASE=0001=DSNDB01   PAGE SET=0086=DSNLLX02

DSN1151I DSN1LPRT MEMBER=DB2A     UR  CONNID=DB2A      CORRID=021.OPNLGR00  AUTHID=SYSOPR    PLAN=SYSTEM
              START DATE=00.161 TIME=11:27:30  DISP=COMMITTED           INFO=COMPLETE
              STARTRBA=0000000000002BB374EF   ENDRBA=0000000000002BB37C81
              STARTLRSN=00CA21F57956411DE000  ENDLRSN=00CA21F5795841E68000
              NID=* LUWID=DSNCAT.SYEC1DB2.CA21F5795571.0001
              COORDINATOR=* PARTICIPANTS=*
              DATA MODIFIED:
                   DATABASE=0001=DSNDB01   PAGE SET=00CF=SYSLGRNX
```

```
                  DATABASE=0001=DSNDB01   PAGE SET=0087=DSNLLX01
                  DATABASE=0001=DSNDB01   PAGE SET=0086=DSNLLX02

....
DSN1213I DSN1LGRD LAST LOG  RBA ENCOUNTERED 0000000000002BBC97A6

DSN1213I DSN1LGRD LAST LOG LRSN ENCOUNTERED 00CA21F5849F250A8000

DSN1224I SPECIFIED LOG LRSNEND 00CA21F586A6D2000000 COULD NOT BE LOCATED FOR MEMBER DB2A

DSN1214I NUMBER OF LOG RECORDS READ 0000000000002571

================================================================================
DSN1157I RESTART SUMMARY

DSN1153I DSN1LSIT CHECKPOINT  MEMBER=DB2A
               STARTRBA=0000000000002BBB8CAC  ENDRBA=0000000000002BBC59E8
               STARTLRSN=00CA21F58479D042C000  ENDLRSN=00CA21F58480E67E4000
               DATE=12.250  TIME=14:20:29

DSN1162I DSN1LPRT  MEMBER=DB2A     UR  CONNID=BATCH     CORRID=ARCHIVE       AUTHID=SYSADM    PLAN=ARCHIVE
             START DATE=00.161 TIME=11:27:30  DISP=INFLIGHT            INFO=COMPLETE
             STARTRBA=0000000000002BBC888E  STARTLRSN=00CA21F5849D6B88E000  NID=*
              LUWID=DSNCAT.SYEC1DB2.CA21F58084CF.0003  COORDINATOR=*
              PARTICIPANTS=*
             DATA MODIFIED:
                  DATABASE=0119=JACKDB    PAGE SET=0002=JACKTS
                  DATABASE=0119=JACKDB    PAGE SET=0005=TESTIX

DSN1160I DATABASE WRITES PENDING:
                  DATABASE=0001=DSNDB01    PAGE SET=0008=DSNDB01X   START=0000000000002BB8BC60
                  DATABASE=0001=DSNDB01    PAGE SET=001F=DBD01      START=0000000000002BB8BED8
                  DATABASE=0006=DSNDB06    PAGE SET=006C=DSNADX01   START=0000000000002BB8EE55
                  DATABASE=0006=DSNDB06    PAGE SET=0787=DSNADH02   START=0000000000002BB8E858
                  DATABASE=0006=DSNDB06    PAGE SET=0076=DSNUCX01
....
```

Figure 131. Sample DSN1LOGP summary report

Description of the detail report

The detail report in the following figure includes the following records:

- Redo and undo log records
- System events log records, including begin and end checkpoint records, begin current status rebuild records, and begin forward and backward recovery records
- Page set control log records, including open and close page set log records, open and close data set log records, set write, reset write, and page set write log records
- UR control log records for the complete or incomplete unit of recovery

You can reduce the volume of the detail log records by specifying one or more of the optional keywords in the DSN1LOGP utility control statement.

```
00000000000023C9EAF6  MEMBER(DB2A    )  TYPE( DBE TABLE CHECKPOINT - DBGC READ)
                      LRSN(00C9C1231139FA000000)  DBID(002B)  OBID(0000)
                      SUBTYPE(DBE TABLE WITH EXCEPTION DATA)

     *LRH* 007A007A 4100001D 0E800000 00000000 000023C9 EA7C0826 000023C9 EA7CC9C1
           231139FA 0001
      0000 00000054 03100000 00000000 00000000 00000000 00000000 00000000 0EC7C4C2
      0020 C5E3002B 00000000 00000000 00000000 C7000000 00C9B6DE A8263200 00000000
      0040 00000000 00000000 00000000 002B0000 00C80000

     HASH RECORD - CHAIN:   43,        LRSN: 00C9B6DEA82632000000

00000000000023C9EB70 MEMBER(DB2A     ) TYPE( DBE TABLE CHECKPOINT - DBGC READ)
```

```
                              LRSN(00C9C1231139FB000000) DBID(002C) OBID(0000)
                              SUBTYPE(DBE TABLE WITH EXCEPTION DATA)
                         *LRH* 007A007A 4100001D 0E800000 00000000 000023C9 EAF60826 000023C9 EAF6C9C1
                               231139FB 0001
                          0000 00000054 03100000 00000000 00000000 00000000 00000000 00000000 0EC7C4C2
                          0020 C5E3002C 00000000 00000000 00000000 C7000000 00C9B6DE A8268A00 00000000
                          0040 00000000 00000000 00000000 002C0000 00C80000

                         HASH RECORD - CHAIN: 44,          LRSN: 00C9B6DEA8268A000000
                    0000000000023C9EBEA MEMBER(DB2A      ) TYPE( DBE TABLE CHECKPOINT - DBGC READ)
                              LRSN(00C9C1231139FC000000) DBID(002D) OBID(0000)
                              SUBTYPE(DBE TABLE WITH EXCEPTION DATA)
                         *LRH* 007A007A 4100001D 0E800000 00000000 000023C9 EB700826 000023C9 EB70C9C1
                               231139FC 0001
                          0000 00000054 03100000 00000000 00000000 00000000 00000000 00000000 0EC7C4C2
                          0020 C5E3002D 00000000 00000000 00000000 C7000000 00C9B6DE A826BC00 00000000

                          0040 00000000 00000000 00000000 002D0000 00C80000
```

Figure 132. Sample DSN1LOGP detail report

Description of data propagation information in the summary report

The sample output in the following figure shows information from the DSN1LOGP summary report about log records of changes to DB2 tables that were defined with DATA CAPTURE CHANGES.

The fields show the following information:

- START RBA and END RBA show the first and last RBAs that are captured for the unit of recovery that was not retrieved. The range that the start and end RBA encompass can include one or all of the SQL statements within the scope of the unit of recovery.
- TABLE LIST OVERFLOW indicates whether more than 10 distinct data capture table IDs were updated by this unit of recovery. This example indicates that no overflow occurred.
- LR WRITTEN shows the number of written log records that represented changes to tables that were defined for data capture and were available to the DB2CDCEX routine. Recursive SQL changes from DB2CDCEX and changes from other attachments that are not associated with DB2CDCEX are not included. If you receive a value of 2147483647, an overflow occurred and the count is not valid.
- LR RETRIEVED is the number of captured RBAs that were retrieved by DB2CDCEX. If you receive a value of 2147483647, an overflow occurred and the count is not valid.
- LR NOT RETRIEVED is the difference between the number of written log records (LR WRITTEN) and the number of retrieved log records (LR RETRIEVED). The following example output shows that four log records were written, and none were retrieved.

```
DATA PROPAGATION INFORMATION:
     START RBA=000004A107F4       END RBA=000004A10A5C           TABLE LIST OVERFLOW=NO
     LR WRITTEN=0000000000000004  LR RETRIEVED=0000000000000000  LR NOT RETRIEVED=0000000000000004
     DATABASE=0112=DBCS1701       PAGESET=0002=TSCS1701          TABLE OBID=0005
```

Figure 133. Sample data propagation information from the summary report

Description of the report on page regression errors

DSN1LOGP reports page regression errors when you specify the CHECK(DATA) option. The value of the SUMMARY option determines whether the utility creates a detail report, a summary report, or both.

A detail report contains the following information for each page regression error:

- DBID
- OBID
- Page number
- Current LRSN or RBA
- Member name
- Previous level
- Previous update
- Date
- Time

A summary report contains the total number of page regressions that the utility found as well as the following information for each table space in which it found page regression errors:

- Database name
- Table space name
- DBID
- OBID

If no page regression errors are found, DSN1LOGP outputs a single message that no page regression errors were found.

The sample output in the following figure shows the detail report when page regression errors are found.

```
Page regression detected:
DBID(0001) OBID(001F) PAGE(00000003)
Current LRSN                          = C93AA29FC3D1
Previous level from current log record = C93AA290845E
Previous update to data page found on log = C93AA29FC3D0

Page regression detected:
DBID(0001) OBID(001F) PAGE(00000002)
Current LRSN                          = C93AA2E1EDEA
Previous level from current log record = C93AA2D380F7
Previous update to data page found on log = C93AA2E1EDE9

Page regression detected:
DBID(0001) OBID(001F) PAGE(00000002)
Current LRSN                          = C93BBD7CD15E
Previous level from current log record = C93BBD7CCA7C
Previous update to data page found on log = C93BBD7CD15B
```

Command text in DSN1LOGP output

Command text is logged automatically. When you run DSN1LOGP with TYPE(0010), the output includes records for commands. Command record output has TYPE(SYSTEM EVENT) and SUBTYPE(TRACE RECORD). The data is in the form of an IFCID 0090 trace record. For example, the following output from DSN1LOGP shows a -STOP DB2 command:

```
00006BFBE999  LRSN(C6CD403EB3AF)  TYPE(SYSTEM EVENT)
              SUBTYPE(TRACE RECORD)
```

```
*LRH* 01400034 00100041 10800000 00000000 00000000 00000726 00000000 00000000 0000C6CD  *                              F
      403EB3AF 0000                                                                      *
0000  011A0000 00000028 00F20001 00000014 00130001 000B60E2 E3D6D740 E3D6D740 C4C2F216  *         2            -STOP DB2
0020  81AB2000 00000040 00560117 005A02A1 16180930 C4E2D5C1 C6CD403E C6CD403E B392DDEE  *a            !      DSNAF    k
0040  00000006 00000006 00000000 E2E3D3C5 C3F14040 40404040 40404040 40404040 C4E2D5C1  *            STLEC1           DSNA
0060  40404040 E2E8C5C3 F1C4C2F2 C6CD403E B3770001 00000000 0000F3F0 0000F3F0 F9F0009C  *    SYEC1DB2F             3090
0080  0200E2E8 E2D6D7D9 4040F0F2 F34BC7C3 E2C3D5F6 F0F2E5C1 F1C14040 F1C14040 40404040  *  SYSOPR  023.GCSCN602VA1A
00A0  40404040 4040E2E8 E2D6D7D9 40400000 00000000 00000000 00000000 00000000 00000000  *      SYSOPR
00C0  00000000 00000000 00004040 40404040 40404040 40404040 40404040 40404040 40404040  *
00E0  40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040  *
0100  40404040 40404040 40404040 00000000 00000000 00000000 0000
```

Interpreting error codes

When an error occurs, DSN1LOGP formats a reason code from the DB2 stand-alone log service in the SYSPRINT output.

DSN1LOGP can abnormally terminate with a user abend code of X'099'. DSN1LOGP finds the corresponding abend reason code in register 15 (at the time of error). If the specified RBA or LRSN range was not found in the input data sets DSN1LOGP will terminate with return code 4.

Related reference:

Registers and return codes (DB2 Administration Guide)

Chapter 46. DSN1PRNT

With the DSN1PRNT stand-alone utility, you can print DB2 VSAM data sets. These data sets can contain table spaces or index spaces, image copy data sets, and sequential data sets that contain DB2 table spaces or index spaces.

A DB2 VSAM data set is a single piece of a nonpartitioned table space or index, a single partition of a partitioned table space or index, or a FlashCopy image copy data set. The input must be a single z/OS sequential or VSAM data set. Concatenation of input data sets is not supported.

Using DSN1PRNT, you can print hexadecimal dumps of DB2 data sets and databases. If you specify the FORMAT option, DSN1PRNT formats the data and indexes for any page that does not contain an error that would prevent formatting. If DSN1PRNT detects such an error, it prints an error message just before the page and dumps the page without formatting. Formatting resumes with the next page.

Compressed records (including the compressed data of dictionary pages) are printed in compressed format.

DSN1PRNT is especially useful when you want to identify the contents of a table space or index. You can run DSN1PRNT on image copy data sets and on table spaces and indexes. DSN1PRNT accepts an index image copy as input when you specify the FULLCOPY option.

You cannot run DSN1PRNT on concurrent copies.

DSN1PRNT is compatible with LOB table spaces, when you specify the LOB keyword and omit the INLCOPY keyword.

DSN1PRNT does not decrypt any encrypted data; the utility displays the data as is.

Output

One intended use of this utility is to aid in determining and correcting system problems. When diagnosing DB2, you might need to refer to licensed documentation to interpret output from this utility.

Environment

Run DSN1PRNT as a z/OS job.

You can run DSN1PRNT even when the DB2 subsystem is not operational. If you choose to use DSN1PRNT when the DB2 subsystem is operational, ensure that the DB2 data sets that are to be printed are not currently allocated to DB2.

To make sure that a data set is not currently allocated to DB2, issue the DB2 STOP DATABASE command, specifying the table spaces and indexes that you want to print.

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Authorization required

No special authorization is required. However, if any of the data sets is RACF protected, the authorization ID of the job must have RACF authority.

Required data sets

DSN1PRNT uses the following DD statements:

SYSPRINT
Defines the data set that contains output messages from DSN1PRNT and all hexadecimal dump output.

SYSUT1
Defines the input data set. That data set can be a sequential data set or a VSAM data set.

Disposition for this data set must be specified as OLD (DISP=OLD) to ensure that it is not in use by DB2. Specify the disposition for this data set as SHR (DISP=SHR) only in circumstances where the DB2 STOP DATABASE command does not work.

The requested operation takes place only for the specified data set. If the input data set belongs to a nonpartitioned table space or index space that is larger than 2 GB, or if it is a partitioned table space or index space, you must ensure the correct data set is specified. For example, to print a page range in the second partition of a four-partition table space, specify NUMPARTS(4) and the data set name of the data set in the group of VSAM data sets comprising the table space. The following code shows the data set name:

```
DSN=...A002
```

If you run the online REORG utility with FASTSWITCH behavior, verify the data set name before running the DSN1PRNT utility. The fifth-level qualifier in the data set name alternates between I0001 and J0001 when using FASTSWITCH. If the table space has cloning, the fifth-level qualifier can be I0002 or J0002. Specify the correct fifth-level qualifier in the data set name to successfully execute the DSN1PRNT utility. To determine the correct fifth-level qualifier, query the IPREFIX column of SYSIBM.SYSTABLEPART for each data partition or the IPREFIX column of SYSIBM.SYSINDEXPART for each index partition. If the object is not partitioned, use zero as the value for the PARTITION column in your query.

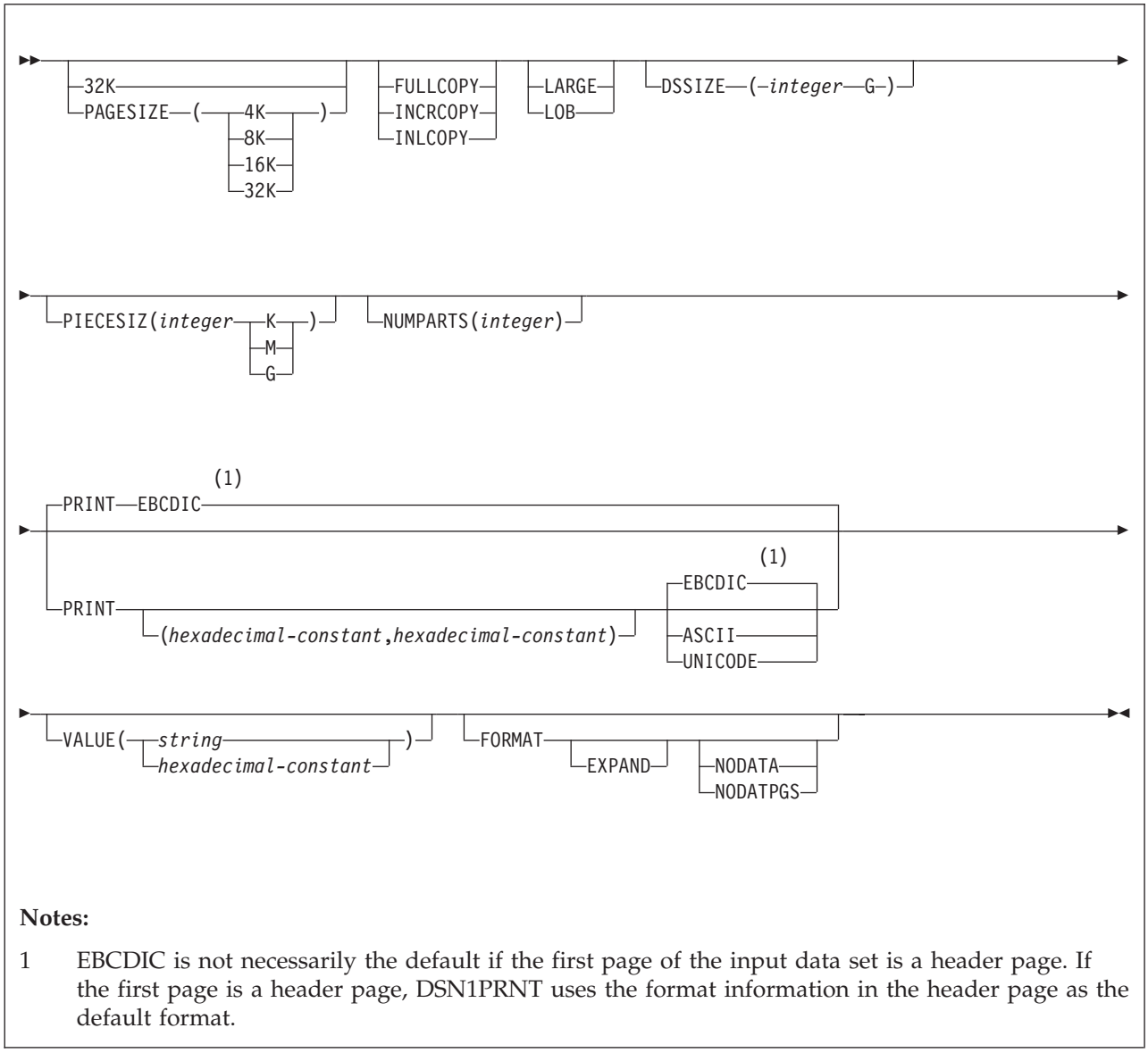
Related information:

DB2 Diagnosis Guide and Reference

Syntax and options of the DSN1PRNT control statement

The DSN1PRNT utility control statement, with its multiple options, defines the function that the utility job performs.

DSN1PRNT syntax diagram



Notes:

1 EBCDIC is not necessarily the default if the first page of the input data set is a header page. If the first page is a header page, DSN1PRNT uses the format information in the header page as the default format.

Option descriptions

If you have the need to run DSN1PRNT with invocation parameters specify one or more of the following options on the EXEC statement.

Important: If you specify more than one parameter:
- Separate them by commas (no blanks).
- Specify them in any order.

Default settings for DSN1PRNT options are taken from the input data set header page. This default processing is recommended when running DSN1PRNT because incorrect parameter settings can result in unpredictable results.

When non-default user values are specified, DSN1PRNT compares the input data set header page settings against the user-specified values whenever possible. If a mismatch is detected, message DSN1930I is issued. The processing is performed with the user-specified values

32K
Specifies that the SYSUT1 data set has a 32-KB page size. If you specify this option and the SYSUT1 data set does not have a 32-KB page size, DSN1COPY might produce unpredictable results.

PAGESIZE
Specifies the page size of the input data set that is defined by SYSUT1. Available page size values are 4K, 8K, 16K, or 32K. If you specify an incorrect page size, DSN1PRNT might produce unpredictable results.

If you do not specify the page size, DSN1PRNT tries to determine the page size from the input data set if the first page of the input data set is a header page. DB2 issues an error message if DSN1PRNT cannot determine the input page size. This might happen if the header page is not in the input data set, or if the page size field in the header page contains an invalid page size.

Related information:

"Determining the page size and data set size for DSN1PRNT" on page 1006

FULLCOPY
Specifies that a DB2 full image copy (not a DFSMSdss concurrent copy) of your data is to be used as input. If this data is partitioned, you also need to specify the NUMPARTS parameter to identify the number and length of the partitions. If you specify FULLCOPY without including a NUMPARTS specification, DSN1PRNT assumes that the input file is not partitioned.

The FULLCOPY parameter must be specified when you use an image copy as input to DSN1PRNT. Omitting the parameter can cause error messages or unpredictable results.

Do not specify FULLCOPY if the input image copy is a FlashCopy image copy data set.

INCRCOPY
Specifies that an incremental image copy of the data is to be used as input. If the data is partitioned, also specify NUMPARTS to identify the number and length of the partitions. If you specify INCRCOPY without NUMPARTS, DSN1PRNT assumes that the input file is not partitioned.

The INCRCOPY parameter must be specified when you use an incremental image copy as input to DSN1PRNT. Omitting the parameter can cause error messages or unpredictable results.

INLCOPY
Specifies that the input data is to be an inline copy data set.

When DSN1PRNT is used to print a page or a page range from an inline copy that is produced by LOAD or REORG, DSN1PRNT prints all instances of the pages. The last instance of the printed page or pages is the last one that is created by the utility.

The INLCOPY parameter must be specified when an inline image copy is used as input to DSN1PRNT. Omitting the INLCOPY parameter can cause error messages or unpredictable results.

LARGE
Specifies that the input data set is a table space that was defined with the

LARGE option, or an index on such a table space. If you specify LARGE, DB2 assumes that the data set has a 4-GB boundary. The recommended method of specifying a table space that was defined with the LARGE option is **DSSIZE(4G)**.

If you omit the LARGE or DSSIZE(4G) option when it is needed, or if you specify LARGE for a table space that was not defined with the LARGE option, the results from DSN1PRNT are unpredictable.

If you specify LARGE, you cannot specify LOB or DSSIZE.

LOB

Specifies that the SYSUT1 data set is a LOB table space. You cannot specify the INLCOPY option with the LOB parameter.

DB2 attempts to determine if the input data set is a LOB data set. If you specify the LOB option but the data set is not a LOB data set, or if you omit the LOB option but the data set is a LOB data set, DB2 issues an error message and DSN1PRNT terminates.

If you specify LOB, you cannot specify LARGE.

DSSIZE(*integer* G)

Specifies the data set size, in gigabytes, for the input data set. If you omit DSSIZE, DB2 obtains the data set size from the data set header page.

If you specify DSSIZE, *integer* must match the DSSIZE value that was specified when the table space was defined.

Related information:

"Determining the page size and data set size for DSN1PRNT" on page 1006

PIECESIZ(*integer*)

Specifies the maximum piece size (data set size) for nonpartitioned indexes. The value that you specify must match the value that is specified when the secondary index was created or altered.

The defaults for PIECESIZ are 2G (2 GB) for indexes that are backed by non-large table spaces and 4G (4 GB) for indexes that are backed by table spaces that were defined with the LARGE option. This option is required if a print range is specified and the piece size is not one of the default values. If PIECESIZ is omitted and the index is backed by a table space that was defined with the LARGE option, the LARGE keyword is required for DSN1PRNT.

The subsequent keyword K, M, or G, indicates the units of the value that is specified in *integer*.

K Indicates that the *integer* value is to be multiplied by 1 KB to specify the maximum piece size in bytes. *integer* must be either 256 or 512.

M Indicates that the *integer* value is to be multiplied by 1 MB to specify the maximum piece size in bytes. *integer* must be a power of 2, between 1 and 512.

G Indicates that the *integer* value is to be multiplied by 1 GB to specify the maximum piece size in bytes. *integer* must be a power of two, between 1 and 256.

Valid values for piece size are:

- 1 MB or 1 GB
- 2 MB or 2 GB
- 4 MB or 4 GB
- 8 MB or 8 GB

- 16 MB or 16 GB
- 32 MB or 32 GB
- 64 MB or 64 FB
- 128 MB or 128 GB
- 256 KB, 256 MB, or 256 GB
- 512 KB or 512 MB

NUMPARTS(*integer***)**
This parameter is not used if the target table space is a universal table space. DSSIZE is used instead.

PRINT(*hexadecimal-constant*,*hexadecimal-constant***)**
Causes the SYSUT1 data set to be printed in hexadecimal format on the SYSPRINT data set. This option is the default for DSN1PRNT.

You can specify the PRINT parameter with or without page range specifications. If you do not specify a range, all pages of the SYSUT1 are printed. If you want to limit the range of pages that are printed, you can do so by indicating the beginning and ending page numbers with the PRINT parameter or, if you want to print a single page, by indicating only the beginning page. In either case, your range specifications must be from one to eight hexadecimal characters in length.

The following example shows how to code the PRINT parameter if you want to begin printing at page X'2F0' and to stop at page X'35C':

```
PRINT(2F0,35C)
```

The relationship between the page size and the number of pages in a 4-GB data set is shown in the following table.

Table 137. Relationship between page size and the number of pages in a 4-GB data set

Page size	Number of pages
4 KB	X'100000'
8 KB	X'80000'
16 KB	X'40000'
32 KB	X'20000'

For example, if PAGESIZE is 4 KB, the page number of the first page of the third data set is 2*X'100000' = X'200000'.

To print only the header page for a nonpartitioned table space, specify PRINT(0).

You can indicate the format of the row data in the PRINT output by specifying EBCDIC, ASCII, or UNICODE. The part of the output that is affected by these options is in bold in the following figure.

```
RECORD:  XOFFSET='0014'X  PGSFLAGS='00'X  PGSLTH=65  PGSLTH='0041'X  PGSOBD='0003'X  PGSBID='01'X
C5C5F0F6 C1404040 40404040 F1F34040 40C1E2D6 F1F3F5E7 40404040 40404040   EE06A       13   AS0135X
C1C6F3F1 C587C6F0 01800000 14199002 01174522 00000080 000000             AF31E.F0..................

RECORD:  XOFFSET='0055'X  PGSFLAGS='00'X  PGSLTH=65  PGSLTH='0041'X  PGSOBD='0003'X  PGSBID='02'X
C5C5F0F6 C1404040 40404040 F1F34040 40C1E2D6 F1F3F5E7 40404040 40404040   EE06A       13   AS0135X
C1C6F5F2 D487C5F0 09800000 78199002 01174522 00000080 000000             AF52M.E0..................
```

Figure 134. The part of the DSN1PRNT FORMAT output that is affected by the EBCDIC, ASCII, and UNICODE options

EBCDIC
Indicates that the row data in the PRINT output is to be displayed in EBCDIC.

The default value is **EBCDIC** if the first page of the input data set is not a header page.

If the first page is a header page, DSN1PRNT uses the format information in the header page as the default format. However, if you specify EBCDIC, ASCII, or UNICODE, that format overrides the format information in the header page. The unformatted header page dump is always displayed in EBCDIC, because most of the fields are in EBCDIC.

ASCII
Indicates that the row data in the PRINT output is to be displayed in ASCII. Specify ASCII when printing table spaces that contain ASCII data.

UNICODE
Indicates that the row data in the PRINT output is to be displayed in Unicode. Specify UNICODE when printing table spaces that contain Unicode data.

VALUE
Causes each page of the input data set SYSUT1 to be scanned for the character string that you specify in parentheses following the VALUE parameter. Each page that contains that character string is then printed in SYSPRINT. You can specify the VALUE parameter in conjunction with any of the other DSN1PRNT parameters.

(*string***)**
Can consist of from 1 to 20 alphanumeric EBCDIC characters. For non-EBCDIC characters, use hexadecimal characters.

(*hexadecimal-constant***)**
Consists of from 2 to 40 hexadecimal characters. You must specify two apostrophe characters before and after the hexadecimal character string.

If, for example, you want to search your input file for the string '12345', your JCL should look like the following JCL:

```
//STEP1 EXEC PGM=DSN1PRNT,PARM='VALUE(12345)'
```

Alternatively, you might want to search for the equivalent hexadecimal character string. If you are processing Unicode or ASCII input files, you must specify the string in hexadecimal. Your JCL should look like the following JCL:

```
//STEP1 EXEC PGM=DSN1PRNT,PARM='VALUE(''3132333435'')'
```

FORMAT
Causes the printed output to be formatted. Page control fields are identified, and individual records are printed. Empty fields are not displayed.

EXPAND
Specifies that the data is compressed and causes DSN1PRNT to expand it before formatting. This option is intended to be used only under the direction of IBM Software Support.

When DSN1PRNT is run with the FORMAT EXPAND option, and the input data sets constitute a full image copy, the input data sets need to contain all pages of the original table space, including all dictionary pages.

FORMAT EXPAND cannot be specified if the INCRCOPY or INLCOPY options are specified.

NODATA
Suppresses printing of table row data. The row headers are formatted and printed. Specify NODATA to reduce the volume of the output when the contents of the rows are not important.

NODATPGS
Suppresses all data pages of a table space. Specify NODATPGS to format and print only non-data pages to reduce the volume of the output when only certain page types are of interest (for example, LOB space map pages). Alternatively, you can specify NODHDR.

DSN1PRNT cannot format a leaf or nonleaf page for an index page set that contains keys with altered columns. When it encounters this situation, DSN1PRNT generates the following message:

```
*KEY WITH ALTERED COLUMN HAS BEEN DETECTED-UNABLE TO FORMAT PAGE*
```

DSN1PRNT generates unformatted output for the page.

FORMAT attempts to format a broken page and dumps the unformatted version of the page following the formatted version.

Related concepts:

"Using VERIFY with REPLACE and DELETE operations" on page 688

Printing with DSN1PRNT instead of DSN1COPY

If you want to print information about a data set, use the DSN1PRNT utility rather than the DSN1COPY utility. DSN1COPY scans the entire SYSUT1 data set, but DSN1PRNT might be able to stop scanning before the end of the data set. Also, the DSN1PRNT utility can write a formatted dump.

Determining the page size and data set size for DSN1PRNT

Before you run the DSN1PRNT utility, you must determine the page size and data set size (DSSIZE) for the page set.

Procedure

To determine the page size and data set size:

Issue a query against the DB2 catalog. For example, the query that is shown in the following figure returns this information for the DEPT table:

```
SELECT T.CREATOR,T.NAME,S.NAME AS TABLESPACE,S.PARTITIONS,S.PGSIZE,
      CASE S.DSSIZE
      WHEN 0 THEN
                  CASE WHEN S.TYPE = 'G' THEN 4194304
                       WHEN S.TYPE = 'L' THEN 4194304
                       WHEN S.TYPE = 'O' THEN 4194304
                       WHEN S.TYPE = 'P' THEN 4194304
                       WHEN S.TYPE = 'R' THEN 4194304
                  ELSE
                       CASE WHEN S.PARTITIONS > 254 THEN
                            CASE WHEN S.PGSIZE = 4  THEN  4194304
                                 WHEN S.PGSIZE = 8  THEN  8388608
                                 WHEN S.PGSIZE = 16 THEN 16777216
                                 WHEN S.PGSIZE = 32 THEN 33554432
                            ELSE NULL
                            END
                            WHEN S.PARTITIONS > 64 THEN 4194304
                            WHEN S.PARTITIONS > 32 THEN 1048576
```

```
                        WHEN S.PARTITIONS > 16 THEN 2097152
                        WHEN S.PARTITIONS > 0  THEN 4194304
                   ELSE 2097152
                   END
              END
ELSE S.DSSIZE
END
AS DSSIZE
FROM SYSIBM.SYSTABLES T,
     SYSIBM.SYSTABLESPACE S
WHERE
     T.NAME = 'DEPT' AND
     T.TSNAME = S.NAME;
```

Related reference:

"Data sets that REORG INDEX uses" on page 533

Sample DSN1PRNT control statements

Use the sample control statements as models for developing your own DSN1PRNT control statements.

Example 1: Printing a data set and formatting the output

The following example specifies that the DSN1PRNT utility is to print the data set that is identified by the SYSUT1 DD statement and the output is to be formatted. This data set is to be printed on the data set that is identified by the SYSPRINT DD statement. The fifth-level qualifier in the data set name can be either I0001 or J0001. This example uses I0001.

```
//jobname JOB acct info
//RUNPRNT EXEC PGM=DSN1PRNT,PARM='PRINT,FORMAT'
//STEPLIB DD DSN=prefix.SDSNLOAD
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD DSN=DSNCAT.DSNDBC.DSNDB01.SYSUTILX.I0001.A001,DISP=SHR
```

Example 2: Printing a nonpartitioning index with a 64-MB piece size

The following example specifies that DSN1PRNT is to print the first 16 pages of the 61st piece of an nonpartitioned index with a piece size of 64 MB. The pages that are to be printed are identified by the PRINT option. These page values are determined as follows: A data set of size 64 MB contains X'4000' 4-KB pages. Decimal 61 is X'3D'. The page number of the first page of the 61st piece is 4000*(3D-1) = 4000*3C = F0000. To print the last 16 pages of the 61st piece, specify `PARM=(PRINT(F3FF0,F3FFF), ...)`.

The fifth-level qualifier in the data set name can be either I0001 or J0001. This example uses I0001.

```
//PRINT2 EXEC PGM=DSN1PRNT,
//            PARM=(PRINT(F0000,F000F),FORMAT,PIECESIZ(64M))
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DISP=OLD,DSN=DSNCAT.DSNDBD.MMRDB.NPI1.I0001.A061
```

Example 3: Printing a single page of an image copy

The following example specifies that DSN1PRNT is to print one page of an image copy. The image copy is identified by the SYSUT1 DD statement. The PRINT option specifies that the only page to be printed is X'1'.

```
//STEP2    EXEC PGM=DSN1PRNT,
//         PARM='PRINT(1),FORMAT,INLCOPY'
//STEPLIB  DD DSN=DB2A.SDSNLOAD,DISP=SHR
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DSN=HUHYU205.L1.STEP1.DD2,DISP=SHR
```

Example 4: Printing a partitioned data set

The following example specifies that DSN1PRNT is to print the data set that is identified by the SYSUT1 DD statement. Because this data set is a table space that was defined with the LARGE option, the DSSIZE(4G) option is specified in the parameter list for DSN1PRNT. You could specify the LARGE option in this list instead, but specifying DSSIZE(4G) is recommended. This input table space has 260 partitions, as indicated by the NUMPARTS option.

```
//RUNPRNT1 EXEC PGM=DSN1PRNT,
//    PARM='DSSIZE(4G),PRINT,NUMPARTS(260),FORMAT'
//STEPLIB  DD DSN=DB2A.SDSNLOAD,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSUT1   DD DSN=DSNCAT.DSNDBC.DBOM0301.TPOM0301.I0001.A259,DISP=SHR
/*
```

Example 5: Printing a page range of a specific partition

It is difficult to determine page numbers for a specific partition of a partitioned table space.

This example describes a simple way of using DSN1PRNT without needing to calculate page numbers.

1. Run DSN1PRNT on the partition you want to process without specifying a PRINT range. Set the FORMAT option to NODATPGS. Data pages are not printed reducing the use of spool space.

   ```
   //    EXEC  PGM=DSN1PRNT,
   //    PARM='FORMAT,NODATPGS,NUMPARTS(8)'
   //SYSUT1   DD DSN=DSNT6USR.DSNDBC.V9DS306.XV9D0000.I0001.A008,DISP=SHR
   ```

   The printout includes page numbers. Use these page numbers to setup another DSN1PRNT job using the appropriate page numbers.
2. Run DSN1PRNT on partition 8 specifying your PRINT range

   ```
   //    EXEC  PGM=DSN1PRNT,
   //    PARM='PRINT(xx000000,xx000020),FORMAT,NUMPARTS(8)'
   //SYSUT1   DD DSN=DSNT6USR.DSNDBC.V9DS306.XV9D0000.I0001.A008,DISP=SHR
   ```

   The page range must be specified in hexadecimal format.

Example 6: Specifying Unicode output for DSN1PRNT

When you specify the UNICODE option for DSN1PRNT, you are not going to see non-Latin Unicode characters, such as Japanese characters, in your output. When you specify the UNICODE option, DSN1PRNT takes the hexadecimal data and formats it as ASCII instead of the default EBCDIC.

A problem might arise when the data that you want DSN1PRNT to handle is in UTF-16. In the case of UTF-16 data, DSN1PRNT takes only the second byte of the data and formats that part of the data as ASCII. Thus, the output might not be correct. For example, the UTF-16 hexadecimal values X'0030' and X'1130' are both output as 0, because the first byte of each ("00" and "11" respectively) is ignored. The remaining part ("30") is interpreted as an ASCII 0. In UTF-16, X'0030' is the

hexadecimal value for 0, but X'1130' is the hexadecimal value for a Hangul character. For more information about UTF-16 format, see UTFs (DB2 Internationalization Guide).

In the following DSN1PRNT example, notice the three bold hexadecimal values: X'0041', X'0141', and X'0241'. The output for all three of these values is A.A.A, even though they each correspond to different characters in UTF-16. (X'0041' is A, X'0141' is ⌂, and X'0241' is the Latin capital character for glottal stop.)

```
//STEP1    EXEC PGM=DSN1PRNT,
//         PARM='FORMAT,PRINT(002),UNICODE'
//STEPLIB  DD DSN=DB2A.DSNLOAD,DISP=SHR
//SYSUDUMP DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSOUT   DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUT1   DD DSN=TESTCAT.DSNDBC.DBED2101.TPED2101.I0001.A001,DISP=SHR
/*
DSN1999I START OF DSN1PRNT FOR JOB DSN1PRNT RUNPRNT9
DSN1989I DSN1PRNT IS PROCESSED WITH THE FOLLOWING OPTIONS:
4K/NO IMAGECOPY/NUMPARTS =   0/   FORMAT/NO EXPAND/   PRINT/NO VALUE/     /   /
DSSIZE=   /PIECESIZ=    /UNICODE/
DSN1998I INPUT  DSNAME = TESTCAT.DSNDBC.DBED2101.TPED2101.I0001.A001 , VSAM

PAGE: # 00000002 ------------------------------------------------------------------------------
DATA PAGE:  PGCOMB='10'X  PGLOGRBA='0000758C9455'X  PGNUM='00000002'X  PGFLAGS='00'X  PGFREE=4041
PGFREE='0FC9'X  PGFREEP=51  PGFREEP='0033'X  PGHOLE1='0000'X  PGMAXID='01'X  PGNANCH=1
PGTAIL:  PGIDFREE='00'X  PGEND='N'

ID-MAP FOLLOWS:
01  0014
RECORD:  XOFFSET='0014'X  PGSFLAGS='02'X  PGSLTH=31  PGSLTH='001F'X  PGSOBD='0003'X  PGSBID='01'X
80000001 00004101 4102400 20002000 20002000 20002000 20                  ......A.A.A. . . . . .

DSN1994I DSN1PRNT COMPLETED SUCCESSFULLY,  00000001 PAGES PROCESSED
```

Chapter 47. DSN1SDMP

IBM Software Support might advise you to use the IFS selective dump (DSN1SDMP) stand-alone utility. DSN1SDMP enables you to force dumps when selected DB2 trace events occur, write DB2 trace records to user-defined z/OS data sets, or start another DB2 trace.

To ensure that you do not take action on an IFCID 4 or IFCID 5 start or stop trace record, it is good practice to add

```
P4,00
DR,04,X'hhhh'
```

to your control statement, where hhhh is the hex representation of the IFCID that you are trying to trigger on.

Output

One intended use of this utility is to aid in determining and correcting system problems. When diagnosing DB2, you might need to refer to licensed documentation to interpret output from this utility.

Environment

Run DSN1SDMP as a z/OS job, and execute it with the DSN TSO command processor. To execute DSN1SDMP, the DB2 subsystem must be running.

The z/OS job completes only under one of the following conditions:

- The TRACE and any additional selection criteria that are started by DSN1SDMP meet the criteria specified in the FOR parameter.
- The TRACE that is started by DSN1SDMP is stopped by using the STOP TRACE command.
- The job is canceled by the operator.

If you must stop DSN1SDMP, use the STOP TRACE command.

Authorization required

To execute this utility, the privilege set of the process must include one of the following privileges or authorities:

- TRACE system privilege
- SYSOPR authority
- SYSADM authority
- MONITOR1 or MONITOR2 privileges (if you are using user-defined data sets)
- SQLADM authority
- System DBADM authority
- SECADM authority

The user who executes DSN1SDMP must have EXECUTE authority on the plan that is specified in the *trace-parameters* of the START TRACE keyword.

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Required data sets

DSN1SDMP uses the following DD statements:

SDMPIN
Defines the control data set that specifies the input parameters to DSN1SDMP. This DD statement is required. The LRECL is 80. Only the first 72 columns are checked by DSN1SDMP.

SDMPPRNT
Defines the sequential message data set that is used for DSN1SDMP messages. If the SDMPPRNT DD statement is omitted, no messages are written. The LRECL is 131.

SYSABEND
Defines the data set that is to contain an ABEND dump in case DSN1SDMP abends. This DD statement is optional.

SDMPTRAC
Defines the sequential DB2 trace record data set that DB2 returns to DSN1SDMP. The DD statement is required only if trace data is written to an OPX trace destination. If the destination is anything other than an OPX buffer, SDMPTRAC is ignored.

Trace records that DB2 writes to SDMPTRAC are of the same format as SMF or GTF records except that the SDMPTRAC trace record headers contain the monitor header (that is mapped by DSNDQWIW). The The DCB parameters are VB, BLKSIZE=32760, LRECL=32756.

SYSTSIN
Defines the DSN commands to connect to DB2 and to execute an IFC selective dump:

```
DSN SYSTEM(subsystem name)
RUN PROG(DSN1SDMP) LIB('prefix.SDSNLOAD') PLAN(DSNEDCL)
```

The DB2 subsystem name must be filled in by the user. The DSN RUN command must specify a plan for which the user has execute authority. DSN1SDMP dump does not execute the specified plan; the plan is used only to connect to DB2.

When no plan name is specified on the DSN RUN command, the default plan name is the program name. When DSN1SDMP is executed without a plan, DSN generates an error if no DSN1SDMP plan exists for which the user has execute authority.

Related reference:

Trace data record format (DB2 Performance)

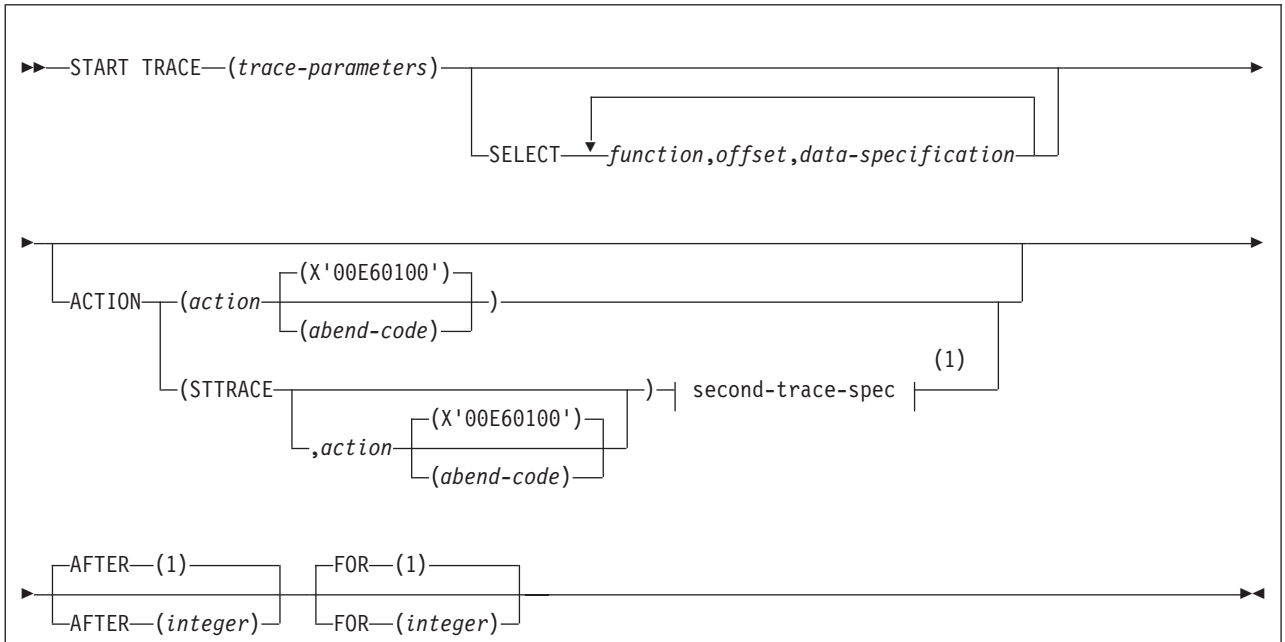
Related information:

DB2 Diagnosis Guide and Reference

Syntax and options of the DSN1SDMP control statement

The DSN1SDMP utility control statement, with its multiple options, defines the function that the utility job performs.

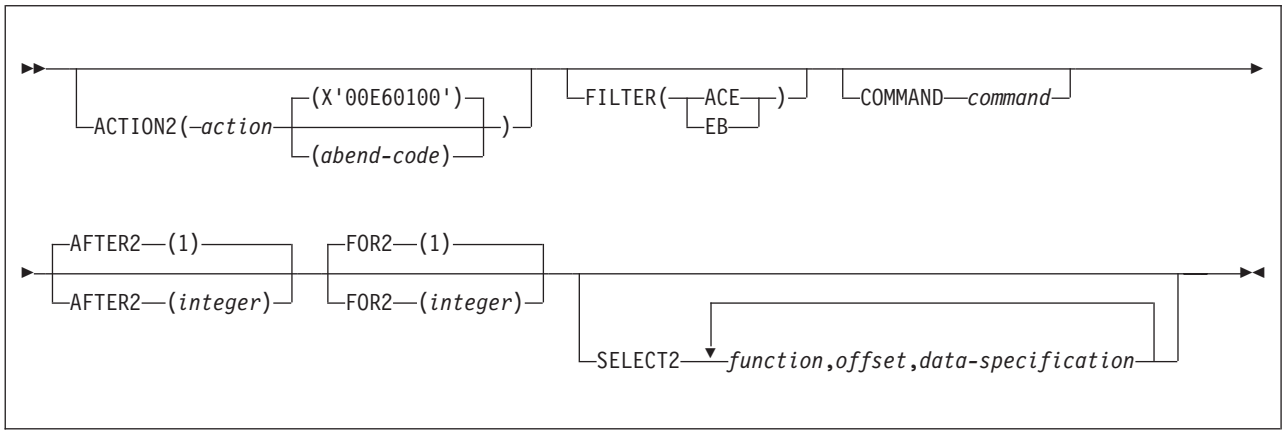
DSN1SDMP syntax diagram



Notes:

1 The options in the *second-trace-spec* do not have to be specified immediately following the STTRACE option. However, they can be specified only if the STTRACE option is also specified.

second-trace-spec:



Option descriptions

START TRACE (*trace-parameters***)**

Indicates the start of a DSN1SDMP job. START TRACE is a required keyword and must be the first keyword that is specified in the SDMPIN input stream.

If the START TRACE command in the SDMPIN input stream is not valid, or if the user is not properly authorized, the IFI (instrumentation facility interface) returns an error code and START TRACE does not take effect. DSN1SDMP writes the error message to the SDMPPRNT data set.

Trace Destination: If DB2 trace data is to be written to the SDMPTRAC data set, the trace destination must be an IFI online performance (OP) buffer. OP buffer destinations are specified in the DEST keyword of START TRACE. Eight OP buffer destinations exist, OP1 to OP8. The OPX trace destination assigns the next available OP buffer. Any record destined for the exclusive internal trace table (RES) is not eligible to be evaluated. For example, if you start IFCID(0) DEST(RES), this will not execute DSN1SDMP logic and cannot be acted upon.

The DB2 output text from the START TRACE command is written to SDMPPRNT.

START TRACE and its associated keywords must be specified first. Specify the remaining selective dump keywords in any order following the START TRACE command.

SELECT *function,offset,data-specification*
Specifies selection criteria in addition to those that are specified on the START TRACE command. SELECT expands the data that is available for selection in a trace record and allows more specific selection of data in the trace record than using START TRACE alone. You can specify a maximum of eight SELECT criteria.

The selection criteria use the concept of the current-record pointer. DB2 initializes the current-record pointer to zero, that is, at the beginning of the trace record. For this instance of the DSN1SDMP trace, the trace record begins with the self-defining section. The current-record pointer can be modified by P*x* and LN functions, which are described in the list of functions below.

You can specify the selection criteria with the following parameters:

function
Specifies the type of search that is to be performed on the trace record. The specified value must be two characters. The possible values are:

DR Specifies a direct comparison of data from the specified offset. The offset is always calculated from the current-record pointer.

GE Specifies a comparison of data that is greater than or equal to the value of the specified offset. The offset is always calculated from the current-record pointer. The test succeeds if the data from the specified offset is greater than or equal to *data-specification*, which you can specify on the SELECT option.

LE Specifies a comparison of data that is less than or equal to the value of the specified offset. The offset is always calculated from the current-record pointer. The test succeeds if the data from the specified offset is less than or equal to *data-specification*, which you specify on the SELECT option.

P1, P2, or P4
Selects the 1-, 2-, or 4-byte field that is located *offset* bytes past the start of the record. The function then moves the current-record pointer that number of bytes into the record. P1, P2, and P4 always start from the beginning of the record (plus the offset that you specify).

This offset is saved as the current-record pointer that is to be used on subsequent DR, LE, GR, and LN requests.

For example, suppose that the user knows that the offset to the standard header is 4 bytes long and is located in the first 4 bytes of the record. P4,00 reads that offset and moves the current-record pointer to the start of the standard header.

LN Advances the current-record pointer by the number of bytes that are indicated in the 2-byte field that is located *offset* bytes from the previous current-record pointer.

This offset is saved as the current-record pointer that is to be used on subsequent DR, LE, GR, and LN requests.

offset
Specifies the number (in decimal) of bytes into the trace record where the comparison with the *data-specification* field begins. The offset starts from the beginning of the trace record after a P1, P2, or P4, and from the current-record pointer after a GE, LE, LN, or DR.

The format of the DB2 trace record at *data-specification* comparison time is shown in the following figure.

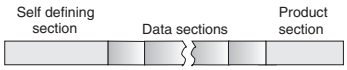


Figure 135. Format of the DB2 trace record at data specification comparison time

- The format of the self-defining section depends on the trace type.
- The format and content of the data sections depend on the IFCID that is being recorded. Each record can have one or more data sections. Each data section can have multiple repeating groups.
- The format and content of the trace header section depends on the trace type.

data-specification
Specifies that the data can be hexadecimal (for example, X'9FECBA10') or character (C'FIELD').

ACTION
Specifies the action to perform when a trace record passes the selection criteria of the START TRACE and SELECT keywords.

Attention: The purpose of the ACTION keyword is to facilitate problem analysis. You should use it with extreme caution because you might damage existing data. Not all abends are recoverable, even if the ABENDRET parameter is specified. Some abends might force the DB2 subsystem to terminate, particularly those abends that occur during end-of-task or end-of-memory processing due to the agent having experienced a previous abend.

action(*abend-code*)
Specifies a particular action to perform. Possible values for *action* are:

ABENDRET
ABEND and retry the agent.

ABENDTER
ABEND and terminate the agent.

An abend reason code can also be specified on this parameter. The codes must be in the range X'00E60100' to X'00E60199'. The default value is X'00E60100'.

STTRACE
Specifies that a second trace is to be started when a trace record passes the selection criteria.

If you do not specify *action* or STTRACE, the record is written and no action is performed.

AFTER(*integer***)**
Specifies that the ACTION is to be performed after the trace point is reached *integer* times.

integer must be between 1 and 32767.

The default value is **AFTER**(**1**).

FOR(*integer***)**
Specifies the number of times that the ACTION is to take place when the specified trace point is reached. After *integer* times, the trace is stopped, and DSN1SDMP terminates.

integer must be between 1 and 32767 and includes the first action. If no SELECT criteria are specified, use an integer greater than 1; the START TRACE command automatically causes the action to take place one time.

The default value is **FOR**(**1**).

ACTION2
Specifies the action to perform when a trace record passes the selection criteria of the START TRACE, SELECT, and SELECT2 keywords.

Attention: The ACTION2 keyword, like the ACTION keyword, should be used with extreme caution, because you might damage existing data. Not all abends are recoverable, even if the ABENDRET parameter is specified. Some abends might force the DB2 subsystem to terminate, particularly those that occur during end-of-task or end-of-memory processing due to the agent having experienced a previous abend.

*action***(***abend-code***)**
Specifies a particular action to perform. Possible values for *action* are:

ABENDRET
ABEND and retry the agent.

ABENDTER
ABEND and terminate the agent.

An abend reason code can also be specified on this parameter. The codes must be in the range X'00E60100-00E60199'. If no abend code is specified, X'00E60100' is used.

If you do not specify *action*, the record is written and no action is performed.

FILTER
Specifies that DSN1SDMP is to filter the output of the second trace based on either an ACE or an EB.

(ACE)
Specifies that DSN1SDMP is to include trace records only for the agent control element (ACE) that is associated with the agent when the first action is triggered and the second trace is started.

(EB)
Specifies that DSN1SDMP is to include trace records only for the execution block (EB) that is associated with the agent when the first action is triggered and the second trace is started.

COMMAND
Indicates that the specified command is to be issued when a trace record passes the selection criteria for the first trace and a second trace is started. You can start a second trace by specifying the STTRACE option.

command
Specifies a specific command to be issued.

FOR2(*integer***)**
Specifies the number of times that the ACTION2 is to take place when the specified second trace point is reached. After *integer* times, the second trace is stopped, and DSN1SDMP terminates.

integer must be between 1 and 32767 and includes the first action. If no SELECT2 criteria are specified, use an integer greater than 1; the STTRACE option automatically causes the action to take place one time.

The default value is **FOR2**(**1**).

AFTER2(*integer***)**
Specifies that the ACTION2 is to be performed after the second trace point is reached *integer* times.

integer must be between 1 and 32767.

The default value is **AFTER2**(**1**).

SELECT2 *function*,*offset*,*data-specification*
Specifies selection criteria for the second trace. This option functions like the SELECT option, except that it pertains to the second trace only. You can start a second trace by specifying the STTRACE option.

Related reference:

-START TRACE (DB2) (DB2 Commands)

Trace field descriptions (DB2 Performance)

Assigning buffers

You must specify the OPX destination for all traces that are being recorded to an OP*n* buffer for the DSN1SDMP utility to use. By specifying the OPX destination, you avoid the possibility of starting a trace to a buffer that is already assigned.

If a trace is started to an OP*n* buffer that has already been assigned, DSN1SDMP waits indefinitely until the trace is manually stopped. The default for MONITOR-type traces is the OPX destination (the next available OP buffer). Other trace types must be explicitly directed to OP destinations via the DEST keyword of the **START TRACE** command. DSN1SDMP interrogates the IFCAOPN field after the START TRACE COMMAND call to determine if the trace was started to an OP buffer.

Trace Destination: If DB2 trace data is to be written to the SDMPTRAC data set, the trace destination must be an IFI online performance (OP) buffer. OP buffer destinations are specified in the DEST keyword of START TRACE. Eight OP buffer destinations exist, OP1 to OP8. The OPX trace destination assigns the next available OP buffer. Any record destined for the exclusive internal trace table (RES) is not eligible to be evaluated. For example, if you start IFCID(0) DEST(RES), this will not execute DSN1SDMP logic and cannot be acted upon.

Trace records are written to the SDMPTRAC data set when the trace destination is an OP buffer. The instrumentation facilities component (IFC) writes trace records to the buffer and posts DSN1SDMP to read the buffer when it fills to half of the buffer size.

You can specify the buffer size on the BUFSIZE keyword of the **START TRACE** command. All returned records are written to SDMPTRAC.

If the number of generated trace records requires a larger buffer size than was specified, you can lose some trace records. If this happens, error message DSN2724I is issued.

Conditions for generating a dump

DSN1SDMP generates a DB2 dump when certain events occur.

DSN1SDMP generates a DB2 dump when all of the following events occur:
- DB2 produces a trace record that satisfies all of the selection criteria.
- You specify an abend action (ABENDRET or ABENDTER).
- The AFTER and FOR conditions for the trace are satisfied.

If all three events occur, an 00E601*xx* abend occurs. *xx* is an integer between 1 and 99 that DB2 obtains from the user-specified value on the ACTION keyword.

Stopping or modifying DSN1SDMP traces

You can stop and modify DSN1SDMP traces.

Procedure

To stop the DSN1SDMP utility:

Issue a STOP TRACE command. For example, if the DSN1SDMP utility does not finish, you can might stop it by issuing the following command:

```
-STOP TRACE=P CLASS(32)
```

DSN1SDMP executes as a stand-alone batch utility without requiring external intervention from the console operator or other programs. During execution, DSN1SDMP issues an IFI READA request to obtain the data from the OP*n* buffer and a STOP TRACE command to terminate the original trace that is started by DSN1SDMP.
A STOP TRACE or MODIFY TRACE command that is entered from a console for the trace that is started by DSN1SDMP causes immediate abnormal termination of DSN1SDMP processing. The IFI READA function terminates with an appropriate IFI termination message and reason code. Additional error messages and reason codes that are associated with the DSN1SDMP STOP TRACE command vary depending on the specific trace command that is entered by the console operator.
If the console operator terminates the original trace by using the STOP TRACE command, the subsequent STOP TRACE command that is issued by DSN1SDMP fails.
If the console operator enters a MODIFY TRACE command and processing of this command completes before the STOP TRACE command is issued by DSN1SDMP, the modified trace is also terminated.

Related reference:

-STOP TRACE (DB2) (DB2 Commands)

Sample DSN1SDMP control statements

Use the sample control statements as models for developing your own DSN1SDMP control statements.

Example 1: Creating the JCL for DSN1SDMP

This example shows the skeleton JCL for a DSN1SDMP job.

```
//DSN1J018 JOB 'IFC SD',CLASS=A,
//         MSGLEVEL=(1,1),USER=SYSADM,PASSWORD=SYSADM,REGION=1024K
//*********************************************************************
//*
//*       THIS IS A SKELETON OF THE JCL USED TO RUN DSN1SDMP.
//*       YOU MUST INSERT SDMPIN DD.
//*
//*********************************************************************
//IFCSD    EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//STEPLIB  DD DISP=SHR,DSN=prefix.SDSNLOAD
//SYSPRINT DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SDMPPRNT DD SYSOUT=*
//SDMPTRAC DD DISP=(NEW,CATLG,CATLG),DSN=IFCSD.TRACE,
//            UNIT=SYSDA,SPACE=(8192,(100,100)),DCB=(DSORG=PS,
//            LRECL=32756,RECFM=VB,BLKSIZE=32760)
//SDMPIN   DD *
//*********************************************************************
//*
//*       INSERT SDMPIN DD HERE.  IT MUST BEGIN WITH A VALID
//*       START TRACE COMMAND (WITHOUT THE SUBSYSTEM RECOGNITION CHAR)
//*
//*********************************************************************

                  (VALID SDMPIN GOES HERE)

/*
//*********************************************************************
//SYSUDUMP DD SYSOUT=*
//SYSTSIN  DD *
 DSN SYSTEM(DSN)
 RUN PROG(DSN1SDMP) PLAN(DSNEDCL)
 END
//*
```

Figure 136. Skeleton JCL for DSN1SDMP

Example 2: Abending and retrying agent on -904 SQL CODE

This example specifies that DB2 is to start a performance trace (which is indicated by the letter A) and activate IFCID 53, 58. To start only those IFCIDs that are specified in the IFCID option, use trace classes 30-32. In this example, trace class 32 is specified. The IFCID 53 and 58 are started and inspected to see if they match the SELECT criteria.

The SELECT option indicates additional criteria for data in the trace record. In this example, the P4,00 positions the current record pointer to the product section. The GE, 04,X'0005' ensures that the IFCID being traced is either an IFCID 53 or 58 and is not an IFCID4 which is automatically generated via the START TRACE

command. The P4,08 positions the current record pointer to data section 1 of the IFCID 53 or 58. A direct comparison is then made at decimal offset 74 for SQL code X''FFFFFC78''.

When a trace record passes the selection criteria of the START TRACE command and SELECT keywords, DSN1SDMP is to perform the action that is specified by the ACTION keyword. In this example, the job is to abend and try again with reason code 00E60188. This action is to take place only once, as indicated by the FOR option. FOR(1) is the default, and is therefore not required to be explicitly specified.

```
//SDMPIN   DD *
 START TRACE=A CLASS(32) IFCID(53,58) DEST(OPX)
 FOR(1)
 AFTER(1)
 ACTION(ABENDRET(00E60188))
 SELECT
 * Position to the product section
 P4,00
 * Ensure QWHSIID = 58 or 53 (not IFCID 4)
 GE,04,X'0005'
 * Position to the data section 1
 P4,08
 * Compare SQLCODE in QW0058SQ or QW0053SQ
 DR,74,X'FFFFFC78'
/*
```

Figure 137. Example job that abends and terminates agent on -904 SQL code

Example 3: Abending and retrying on RMID 20

This example specifies that DB2 is to start a performance trace (which is indicated by the letter P) and activate all IFCIDs in classes 3 and 8. The trace output is to be recorded in a generic destination that uses the first free OP*n* slot, as indicated by the DEST option. The TDATA (TRA) option specifies that a CPU header is to be placed into the product section of each trace record.

The SELECT option indicates additional criteria for data in the trace record. In this example, the SELECT option first specifies that the current-record pointer is to be placed at the 4-byte field that is located at the start of the record. The current record pointer is then to be advanced the number of bytes that are indicated in the 2-byte field that is located at the current record pointer. The utility is then to directly compare the data that is 4 bytes from the current-record pointer with the value X'0025'.

When a trace record passes the selection criteria of the START TRACE command and SELECT keywords, DSN1SDMP is to perform the action that is specified by the ACTION keyword. In this example, the job is to abend and retry the agent.

```
//*       ABEND AND RETRY AN AGENT WHEN EVENT ID X'0025'
//*       (AGENT ALLOCATION) IS RECORDED BY RMID 20 (SERVICE
//*       CONTROLLER).
//*
//SDMPIN   DD *
*  ENSURE ONLY THE TRACE HEADER IS APPENDED WITH THE STANDARD HEADER
*  VIA THE TDATA KEYWORD ON START TRACE
 START TRACE=P CLASS(3,8) RMID(20) DEST(OPX) TDATA(TRA)
*  ABEND AND RETRY THE AGENT WITH THE DEFAULT ABEND CODE (00E60100)
 ACTION(ABENDRET)
*  SPECIFY THE SELECT CRITERIA FOR RMID.EID
 SELECT
*  OFFSET TO THE STANDARD HEADER
 P4,00
*  ADD LENGTH OF STANDARD HEADER TO GET TO TRACE HEADER
 LN,00
*  LOOK FOR EID 37 AT OFFSET 4 IN THE TRACE HEADER
 DR,04,X'0025'
/*
```

Figure 138. Example job that abends and retries on RMID 20

Example 4: Generating a dump on SQLCODE -811 RMID16 IFCID 5

This example specifies that DB2 is to start a performance trace (which is indicated by the letter P) and activate all IFCIDs in class 3. The trace output is to be recorded in the system management facility (SMF). The TDATA (COR,TRA) option specifies that a trace header and a CPU header are to be placed into the product section of each trace record.

The SELECT option indicates additional criteria for data in the trace record. In this example, the SELECT option first specifies that the current-record pointer is to be placed at the 4-byte field that is located at the start of the record. The utility is then to directly compare the data that is 2 bytes from the current-record pointer with the value X'0116003A'. The current record pointer is then to be moved to the 4-byte field that is located 8 bytes past the start of the current record. The utility is then to directly compare the data that is 74 bytes from the current-record pointer with the value X'FFFFFCD5'.

When a trace record passes the selection criteria of the START TRACE command and SELECT keywords, DSN1SDMP is to perform the action that is specified by the ACTION keyword. In this example, the job is to abend with reason code 00E60188 and retry the agent. This action is to take place only once, as indicated by the FOR option. FOR(1) is the default, and is therefore not required to be explicitly specified. AFTER(1) indicates that this action is to be performed the first time the trace point is reached. AFTER(1) is also the default.

```
//SDMPIN   DD *
 START TRACE=P CLASS(3) RMID(22) DEST(SMF) TDATA(COR,TRA)
 AFTER(1)
 FOR(1)
 SELECT
* POSITION TO HEADERS (QWHS IS ALWAYS FIRST)
  P4,00
* CHECK QWHS 01, FOR RMID 16, IFCID 58
  DR,02,X'0116003A'
* POSITION TO SECOND SECTION (1ST DATA SECTION)
  P4,08
* COMPARE SQLCODE FOR 811
  DR,74,X'FFFFFCD5'
 ACTION(ABENDRET(00E60188))
/*
```

Figure 139. Example job that generates a dump on SQL code -811 RMID16 IFCID

Example 5: Starting a second trace

This example job starts a trace on IFC 196 records. An IFC 196 record is written when a lock timeout occurs. In this example, when a lock timeout occurs, DSN1SDMP is to start a second trace, as indicated by the ACTION(STTRACE) option. This second trace is to be an accounting trace, as indicated by the COMMAND START TRACE(ACCTG) option. This trace is to include records only for the ACE that is associated with the agent that timed out, as indicated by the FILTER(ACE) option. When the qualifying accounting record is found, DSN1SDMP generates a dump.

```
//SDMPIN   DD   *
* START ONLY IFCID 196, TIMEOUT
 START TRACE=P CLASS(32) IFCID(196) DEST(SMF)
 AFTER(1)
* ACTION = START ACCOUNTING TRACE
 ACTION(STTRACE)
* FILTER ON JUST 196 RECORDS...
 SELECT
 P4,00
 DR,04,X'00C4'
* WHEN ACCOUNTING IS CUT, ABEND
 ACTION2(ABENDRET(00E60188))
* START THE ACCOUNTING TRACE FILTER ON THE ACE OF THE AGENT
* THAT TIMED OUT
 COMMAND
 START TRACE(ACCTG) CLASS(32) IFCID(3) DEST(SMF)
* Filter can be for ACE or EB
 FILTER(ACE)
 /*
```

Figure 140. Example job that starts a second trace.

Related reference:

-STOP TRACE (DB2) (DB2 Commands)

Part 4. Appendixes

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Appendix A. Limits in DB2 for z/OS

DB2 for z/OS has system limits, object and SQL limits, length limits for identifiers and strings, and limits for certain data type values.

System storage limits might preclude the limits specified in this section. The limit for items not that are not specified below is limited by system storage.

The following table shows the length limits for identifiers.

Table 138. Identifier length limits. The term *byte(s)* in this table means the number of bytes for the UTF-8 representation unless noted otherwise.

Item	Limit
External-java-routine-name	1305 bytes
Name of an alias [1], auxiliary table, collection, clone table, constraint, correlation, cursor (except for DECLARE CURSOR WITH RETURN or the EXEC SQL utility), distinct type (both parts of two-part name), function (both parts of two-part name), host identifier, index, JARs, parameter, procedure, role, schema, sequence, specific, statement, storage group, savepoint, SQL condition, SQL label, SQL parameter, SQL variable, synonym, table, trigger, view, XML attribute name, XML element name	128 bytes
Name of an authorization ID or name of a security label.	8 bytes
Routine version identifier	64 EBCDIC bytes, and the UTF-8 representation of the name must not exceed 122 bytes.
Name of a column	30 bytes [1]
Name of cursor that is created with DECLARE CURSOR WITH RETURN	30 bytes
Name of cursor that is created with the EXEC SQL utility	8 bytes
Name of a location	16 bytes
Name of buffer pool name, catalog, database, plan, program, table space	8 bytes
Name of package	8 bytes (Only 8 EBCDIC characters are used for packages that are created with the BIND PACKAGE command. 128 bytes can be used for packages that are created as a result of the CREATE FUNCTION (SQL scalar) statement, the CREATE PROCEDURE (SQL - native) statement, the CREATE TRIGGER statement, or a BIND command that specifies a zFS file as DBRM library.)
Name of a profile that is created with CREATE TRUSTED CONTEXT or ALTER TRUSTED CONTEXT	127 bytes

Notes:

1. If the column name length or the distinct type schema or name length is greater than 30 Unicode bytes, truncation occurs in the sqlname field of the SQLDA when those objects are described in an application.

Table 139 on page 1026 shows the minimum and maximum limits for numeric values.

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Table 139. Numeric limits

Item	Limit
Smallest SMALLINT value	-32768
Largest SMALLINT value	32767
Smallest INTEGER value	-2147483648
Largest INTEGER value	2147483647
Smallest BIGINT value	-9223372036854775808
Largest BIGINT value	9223372036854775807
Smallest REAL value	About -7.2×10^{75}
Largest REAL value	About 7.2×10^{75}
Smallest positive REAL value	About 5.4×10^{-79}
Largest negative REAL value	About -5.4×10^{-79}
Smallest FLOAT value	About -7.2×10^{75}
Largest FLOAT value	About 7.2×10^{75}
Smallest positive FLOAT value	About 5.4×10^{-79}
Largest negative FLOAT value	About -5.4×10^{-79}
Smallest DECIMAL value	$1 - 10^{31}$
Largest DECIMAL value	$10^{31} - 1$
Largest decimal precision	31
Smallest DECFLOAT(16) value[1]	$-9.999999999999999 \times 10^{384}$
Largest DECFLOAT(16) value[1]	$9.999999999999999 \times 10^{384}$
Smallest positive DECFLOAT(16) value[1]	$1.000000000000000 \times 10^{-383}$
Largest negative DECFLOAT(16) value[1]	$-1.000000000000000 \times 10^{-383}$
Smallest DECFLOAT(34) value[1]	$-9.999999999999999999999999999999999 \times 10^{6144}$.
Largest DECFLOAT(34) value[1]	$9.999999999999999999999999999999999 \times 10^{6144}$.
Smallest positive DECFLOAT(34) value[1]	$1.000000000000000000000000000000000 \times 10^{-6143}$
Largest negative DECFLOAT(34) value[1]	$-1.000000000000000000000000000000000 \times 10^{-6143}$
Coefficient length for DECFLOAT values	DECFLOAT(16) is 16 digits; DECFLOAT(34) is 34 digits
Maximum Exponent (E_{max}) for DECFLOAT values	DECFLOAT(16) is 384; DECFLOAT(34) is 6144
Minimum Exponent (E_{min}) for DECFLOAT values	DECFLOAT(16) is -383; DECFLOAT(34) is -6143
Bias for DECFLOAT values	DECFLOAT(16) is 398; DECFLOAT(34) is 6176

Note:

1. These are the limits for normal numbers in DECFLOAT. DECFLOAT also contains special values such as NaN and Infinity that are also valid. DECFLOAT also supports subnormal numbers that are outside of the documented range.

The following table shows the length limits for strings.

Table 140. String length limits

Item	Limit
Maximum length of CHAR	255 bytes
Maximum length of GRAPHIC	127 double-byte characters
Maximum length of BINARY	255 bytes

Table 140. String length limits (continued)

Item	Limit
Maximum length[1] of VARCHAR	• 4046 bytes for a column in a table in a table space with 4 KB pages • 8128 bytes for a column in a table in a table space with 8 KB pages • 16320 bytes for a column in a table in a table space with 16 KB pages • 32704 bytes for a column in a table in a table space with 32 KB pages Otherwise, 32704 bytes
Maximum length of VARCHAR that can be indexed by an XML index	1000 bytes after conversion to UTF-8
Maximum length[1] of VARGRAPHIC	• 2023 double-byte characters for a column in a table in a table space with 4 KB pages • 4064 double-byte characters for a column in a table in a table space with 8 KB pages • 8160 double-byte characters for a column in a table in a table space with 16 KB pages • 16352 double-byte characters for a column in a table in a table space with 32 KB pages Otherwise, 16352 double-byte characters
Maximum length of VARBINARY	32704 bytes
Maximum length of CLOB	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of DBCLOB	1 073 741 823 double-byte characters
Maximum length of BLOB	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of a character constant	32704 UTF-8 bytes
Maximum length of a hexadecimal character constant	32704 hexadecimal digits
Maximum length of a graphic string constant	16352 double-byte characters (32704 bytes when expressed in UTF-8)
Maximum length of a hexadecimal graphic string constant	32704 hexadecimal digits
Maximum length of a text string used for a scalar expression	4000 UTF-8 bytes
Maximum length of a concatenated character string	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of a concatenated graphic string	1 073 741 824 double-byte characters
Maximum length of a concatenated binary string	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of XML pattern text	4000 bytes after conversion to UTF-8
Maximum length of an XML element or attribute name in an XML document	1000 bytes
Maximum length of a namespace uri	1000 bytes
Maximum length of a namespace prefix	998 bytes
Largest depth of an internal XML tree	128 levels

Note:

1. The maximum length can be achieved only if the column is the only column in the table. Otherwise, the maximum length depends on the amount of space remaining on a page.

The following table shows the minimum and maximum limits for datetime values.

Table 141. Datetime limits

Item	Limit
Smallest DATE value (shown in ISO format)	0001-01-01
Largest DATE value (shown in ISO format)	9999-12-31
Smallest TIME value (shown in ISO format)	00.00.00
Largest TIME value (shown in ISO format)	24.00.00
Smallest TIMESTAMP WITHOUT TIME ZONE value	0001-01-01-00.00.00.000000000000
Largest TIMESTAMP WITHOUT TIME ZONE value	9999-12-31-24.00.00.000000000000 [1]
Smallest TIMESTAMP WITH TIME ZONE value	0001-01-01-00.00.00.000000000000 +00:00
Largest TIMESTAMP WITH TIME ZONE value	9999-12-31-24.00.00.000000000000 +00:00 [1]
TIMESTAMP precision range	0 to 12
TIME ZONE hour range	-24 to 24
TIME ZONE minute range	0 to 59

Note:

1. The maximum value is stated as a UTC value. When a timestamp without a time zone is compared to a timestamp with time zone, a necessary adjustment is made using the implicit time zone. During that adjustment, the timestamp without time zone could be converted to a value that is greater than the maximum value for a timestamp with time zone value (this could occur on operations such as comparison and assignment). This situation can be avoided by using '9999-12-30-00.00.00.000000000000' as the maximum value for timestamp without time zone and '9999-12-30-00.00.00.000000000000 +00:00' as the maximum value for timestamp with time zone columns.

The following table shows the DB2 limits on SQL statements.

Table 142. DB2 limits on SQL statements

Item	Limit
Maximum number of columns that are in a table or view (the value depends on the complexity of the CREATE VIEW statement) or columns returned by a table function.	750 or fewer (including hidden columns) 749 if the table is a dependent
Maximum number of base tables in a view, SELECT, UPDATE, INSERT, MERGE, or DELETE	225
Maximum number of rows that can be inserted with a single INSERT or MERGE statement	32767
Maximum row and record sizes for a table	See the maximum record size table under CREATE TABLE.
Maximum number of volume IDs in a storage group	133
Maximum number of partitions in a partitioned table space or partitioned index	64 for table spaces that are not defined with LARGE or a DSSIZE greater than 2 GB. 4096, depending on what is specified for DSSIZE or LARGE and the page size.
Maximum sum of the lengths of limit key values of a partition boundary	765 UTF-8 bytes

Table 142. DB2 limits on SQL statements (continued)

Item	Limit
Maximum size of a partition (table space or index)	For table spaces that are not defined with LARGE or a DSSIZE greater than 2 GB: 4 GB, for 1 to 16 partitions 2 GB, for 17 to 32 partitions 1 GB, for 33 to 64 partitions For table spaces that are defined with LARGE or a DSSIZE of 4 GB: 4 GB, for 1 to 4096 partitions For table spaces that are defined with a DSSIZE greater than 4 GB: 256 GB, depending on the page size (for 1 to 64 partitions for 4 KB pages, for 1 to 128 partitions for 8 KB pages, for 1 to 256 partitions for 16 KB pages, and 1 to 512 partitions for 32 KB pages)
Maximum size of a non-partitioned index for a partitioned table space	For 5-byte EA table spaces: 16 TB for 4 KB pages 32 TB for 8 KB pages 64 TB for 16 KB pages 128 TB for 32 KB pages For table spaces that are defined with LARGE: 16 TB
Maximum length of an index key	Partitioning index: 255-*n* Nonpartitioning index that is padded: 2000-*n* Nonpartitioning index that is not padded: 2000-*n*-2*m* Where *n* is the number of columns in the key that allow nulls and *m* is the number of varying-length columns in the key
Maximum number of bytes used in the partitioning of a partitioned index	255 (This maximum limit is subject to additional limitations, depending on the number of partitions in the table space. The number of partitions * (106 + limit key size) must be less than 65394.)
Maximum number of columns in an index key	64
Maximum number of expressions in an index key	64
Maximum number of tables in a FROM clause	225 or fewer, depending on the complexity of the statement
Maximum number of subqueries in a statement	224
Maximum total length of host and indicator variables pointed to in an SQLDA	32767 bytes 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations that are imposed by the application environment and host language
Maximum size of application SQLDA for any statement that references host variables or parameter markers	99016 bytes
Maximum length of host variable used for insert or update operation	32704 bytes for a non-LOB 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations that are imposed by the application environment and host language
Maximum length of an SQL statement	2 097 152 bytes

Table 142. DB2 limits on SQL statements (continued)

Item	Limit
Maximum number of elements in a select list	750 or fewer, depending on whether the select list is for the result table of static scrollable cursor[1]
Maximum number of predicates in a WHERE or HAVING clause	Limited by storage
Maximum total length of columns of a query operation requiring a sort key (SELECT DISTINCT, ORDER BY, UNION, EXCEPT, and INTERSECT, without the ALL keyword, and the DISTINCT keyword for aggregate functions)	4032 bytes
Maximum total length of columns of a query operation requiring sort and evaluating column functions (MULTIPLE DISTINCT and GROUP BY)	65529 bytes
Maximum length of a sort key	16000 bytes
Maximum length of a check constraint	3800 bytes
Maximum number of bytes that can be passed in a single parameter of an SQL CALL statement	32765 bytes for a non-LOB 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations imposed by the application environment and host language
Maximum number of stored procedures, triggers, and user-defined functions that an SQL statement can implicitly or explicitly reference	64 nesting levels
Maximum length of the SQL path	2048 bytes
Maximum length of a WLM environment name in a CREATE PROCEDURE, CREATE FUNCTION, ALTER PROCEDURE, or ALTER FUNCTION statement.	32 bytes
Maximum number of XPath level in the XMLPATTERN clause of the CREATE INDEX statement.	50 nesting levels

Note:

1. If the scrollable cursor is read-only, the maximum number is 749 less the number of columns in the ORDER BY that are not in the select list. If the scrollable cursor is not read-only, the maximum number is 747.

The following table shows the DB2 system limits.

Table 143. DB2 system limits

Item	Limit
Maximum number of concurrent DB2 or application agents	Limited by the EDM pool size, buffer pool size, and the amount of storage that is used by each DB2 or application agent
Maximum number of concurrently active audit policies	32
Maximum size of a non-LOB table or table space	128 terabytes (TB)
Maximum size of a simple or segmented table space	64 GB
Maximum size of a log space	6-byte format: 2^{48} bytes 10-byte format: 2^{80} bytes
Maximum size of an active log data set	4 GB minus 1 byte
Maximum size of an archive log data set	4 GB minus 1 byte
Maximum number of active log copies	2

Table 143. DB2 system limits (continued)

Item	Limit
Maximum number of archive log copies	2
Maximum number of active log data sets (each copy)	93
Maximum number of archive log volumes (each copy)	10000
Maximum number of databases accessible to an application or user	Limited by system storage and EDM pool size
Maximum number of databases	65217
Maximum number of implicitly created databases	Maximum value of the sequence SYSIBM.DSNSEQ_IMPLICITDB, with a default of 10000
Maximum number of internal objects for each database [1]	32767
Maximum number of indexes on declared global temporary tables	10000
Maximum size of an EDM pool	The installation parameter maximum depends on available space
Maximum number of rows per page	255 for all table spaces except catalog and directory tables spaces, which have a maximum of 127
Maximum simple or segmented data set size	2 GB
Maximum partitioned data set size	See item "maximum size of a partition" in Table 142 on page 1028
Maximum LOB data set size	256 GB
Maximum number of table spaces that can be defined in a work file database	500
Maximum number of tables and triggers that can be defined in a work file database	11767

Note:

1. The number of internal object descriptors (OBDs) for external objects are as follows:
   - Table space: 2
   - Table: 1
   - Index: 2
   - Check constraint: 1
   - Referential integrity relationship: 2
   - Auxiliary relationship for each LOB column: 1
   - XML relationship for each XML column: 1
   - Trigger: 1
   - View that has an INSTEAD OF trigger: 1

Appendix B. DB2-supplied stored procedures for utility operations

DB2 provides some stored procedures that you can call in your application programs to perform a number of utility functions. Typically, these procedures are created during installation or migration.

DSNUTILS stored procedure (deprecated)

The DSNUTILS stored procedure enables you use the SQL CALL statement to execute DB2 utilities from a DB2 application program that specifies EBCDIC input.

Restriction: DSNUTILS has been deprecated in favor of DSNUTILU.

Recommendation: Convert existing callers of SYSIBM.SYSUTILS to use the SYSIBM.SYSUTILU stored procedure.

DSNUTILS must run in a WLM environment. The DSNWLM_UTILS environment is created for DB2 utilities stored procedures DSNUTILS and DSNUTILU only. Stored procedures require special data set allocations. If you plan to run other applications in this environment other than DSNUTILS or DSNUTILU, add the procedure and add the DCB information for SYSIN. For example,

```
//SYSIN    DD    UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND),
//         DCB=(RECFM=V,LRECL=32708)
```

When called, DSNUTILS performs the following actions:

- Dynamically allocates the specified data sets
- Creates the utility input (SYSIN) stream
- Invokes DB2 utilities (program DSNUTILB)
- Deletes all the rows that are currently in the created temporary table (SYSIBM.SYSPRINT)
- Captures the utility output stream (SYSPRINT) into a created temporary table (SYSIBM.SYSPRINT)
- Declares a cursor to select from SYSPRINT:

  ```
  DECLARE SYSPRINT CURSOR WITH RETURN FOR
    SELECT SEQNO, TEXT FROM SYSPRINT
    ORDER BY SEQNO;
  ```

- Opens the SYSPRINT cursor and returns.

The calling program then fetches from the returned result set to obtain the captured utility output.

Environment for DSNUTILS

DSNUTILS **must** run in a WLM environment. The DSNWLM_UTILS environment is created for DB2 utilities stored procedures. Stored procedures require special DD allocations.

Table 144. DSNWLM_UTILS environment

Property	Description

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Table 144. DSNWLM_UTILS environment (continued)

NUMTCB	1
APF authorized	Yes

Special DDs	These DDs are required:
	• SYSIN Allocates a work file for temporarily storing utility input statements.
	• SYSPRINT Allocates a work file for temporarily storing utility output messages.
	• RNPRIN01 Allocates a data set for messages from the sort program. Required only if you plan to invoke RUNSTATS and collect distribution statistics.
	• UTPRINT Allocates a data set for messages from the sort program.
	• DSSPRINT Allocates a data set for messages when making concurrent copies.
	Example:
	`//UTPRINT DD SYSOUT=*`
	`//RNPRIN01 DD SYSOUT=*`
	`//DSSPRINT DD SYSOUT=*`
	`//SYSIN DD UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)`
	`//SYSPRINT DD UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)`

Other considerations	The STEPLIB needs to include DSN=prefix.SDSNEXIT or other library where the authorization exit modules (DSN3@ATH and DSN3@SGN) reside.

Installation job DSNTIJMV creates an address space proc called DSNWLMU for DSNWLM_UTILS. When the installation CLIST is customized, the name and library name of this proc are changed according to the DB2 subsystem name you specified on panel DSNTIPM in the field SUBSYSTEM NAME. For example, if you specified a subsystem name of VA1A then this proc will be named VA1AWLMU.

Authorization required for DSNUTILS

To execute the CALL statement, the owner of the package or plan that contains the CALL statement must have one or more of the following privileges on each package that the stored procedure uses:

- The EXECUTE privilege on the package for DSNUTILS
- Ownership of the package
- PACKADM authority for the package collection
- SYSADM authority

Then, to execute the utility, you must use a privilege set that includes the authorization to run the specified utility.

Control statement for DSNUTILS

DSNUTILS dynamically allocates the specified data sets. Any utility that requires a sort must include the SORTDEVT keyword in the utility control statement, and optionally, the SORTNUM keyword.

If the DSNUTILS stored procedure invokes a new utility, refer to Table 145 on page 1035 for information about the default data dispositions that are specified for

dynamically allocated data sets. This table lists the DD name that is used to identify the data set and the default dispositions for the data set by utility.

Table 145. Data dispositions for dynamically allocated data sets

DD name	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSREC	ignored	ignored	ignored	ignored	OLD KEEP KEEP	ignored	ignored	ignored	NEW CATLG CATLG	NEW CATLG CATLG
SYSDISC	ignored	ignored	ignored	ignored	NEW CATLG CATLG	ignored	ignored	ignored	NEW CATLG CATLG	ignored
SYSPUNCH	ignored	ignored	ignored	ignored	ignored	ignored	ignored	ignored	NEW CATLG CATLG	NEW CATLG CATLG
SYSCOPY	ignored	ignored	NEW CATLG CATLG	ignored	NEW CATLG CATLG	NEW CATLG CATLG	ignored	ignored	NEW CATLG CATLG	ignored
SYSCOPY2	ignored	ignored	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	ignored	ignored	NEW CATLG CATLG	ignored
SYSRCPY1	ignored	ignored	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	ignored	ignored	NEW CATLG CATLG	ignored
SYSRCPY2	ignored	ignored	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	NEW CATLG CATLG	ignored	ignored	NEW CATLG CATLG	ignored
SYSUT1	NEW DELETE CATLG	NEW DELETE CATLG	ignored	ignored	NEW DELETE CATLG	ignored	NEW DELETE CATLG	NEW CATLG CATLG	NEW DELETE CATLG	ignored
SORTOUT	NEW DELETE CATLG	ignored	ignored	ignored	NEW DELETE CATLG	ignored	ignored	ignored	NEW DELETE CATLG	ignored
SYSMAP	ignored	ignored	ignored	ignored	NEW CATLG CATLG	ignored	ignored	ignored	ignored	ignored
SYSERR	NEW CATLG CATLG	ignored	ignored	ignored	NEW CATLG CATLG	ignored	ignored	ignored	ignored	ignored
FILTER	ignored	ignored	NEW DELETE CATLG	ignored	ignored	ignored	ignored	ignored	ignored	ignored

If the DSNUTILS stored procedure restarts a current utility, refer to Table 146 for information about the default data dispositions that are specified for dynamically-allocated data sets on RESTART. This table lists the DD name that is used to identify the data set and the default dispositions for the data set by utility.

Table 146. Data dispositions for dynamically allocated data sets on RESTART

DD name	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSREC	ignored	ignored	ignored	ignored	OLD KEEP KEEP	ignored	ignored	ignored	MOD CATLG CATLG	MOD CATLG CATLG
SYSDISC	ignored	ignored	ignored	ignored	MOD CATLG CATLG	ignored	ignored	ignored	MOD CATLG CATLG	ignored
SYSPUNCH	ignored	ignored	ignored	ignored	ignored	ignored	ignored	ignored	MOD CATLG CATLG	MOD CATLG CATLG

Table 146. Data dispositions for dynamically allocated data sets on RESTART (continued)

DD name	CHECK DATA	CHECK INDEX or CHECK LOB	COPY	COPY-TOCOPY	LOAD	MERGE-COPY	REBUILD INDEX	REORG INDEX	REORG TABLE-SPACE	UNLOAD
SYSCOPY	ignored	ignored	MOD CATLG CATLG	ignored	MOD CATLG CATLG	MOD CATLG CATLG	ignored	ignored	MOD CATLG CATLG	ignored
SYSCOPY2	ignored	ignored	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	ignored	ignored	MOD CATLG CATLG	ignored
SYSRCPY1	ignored	ignored	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	ignored	ignored	MOD CATLG CATLG	ignored
SYSRCPY2	ignored	ignored	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	MOD CATLG CATLG	ignored	ignored	MOD CATLG CATLG	ignored
SYSUT1	MOD DELETE CATLG	MOD DELETE CATLG	ignored	ignored	MOD DELETE CATLG	ignored	MOD DELETE CATLG	MOD CATLG CATLG	MOD DELETE CATLG	ignored
SORTOUT	MOD DELETE CATLG	ignored	ignored	ignored	MOD DELETE CATLG	ignored	ignored	ignored	MOD DELETE CATLG	ignored
SYSMAP	ignored	ignored	ignored	ignored	MOD CATLG CATLG	ignored	ignored	ignored	ignored	ignored
SYSERR	MOD CATLG CATLG	ignored	ignored	ignored	MOD CATLG CATLG	ignored	ignored	ignored	ignored	ignored
FILTER	ignored	ignored	MOD DELETE CATLG	ignored	ignored	ignored	ignored	ignored	ignored	ignored

DSNUTILS stored procedure syntax diagram

The following syntax diagram shows the SQL CALL statement for invoking utilities as a stored procedure. Because the linkage convention for DSNUTILS is GENERAL, you cannot pass null values for input parameters. For character parameters that you are not using, specify an empty string ('').

DSNUTILS option descriptions

utility-id
Specifies a unique identifier for this utility within DB2.

This is an input parameter of type VARCHAR(16) in EBCDIC.

restart
Specifies whether DB2 is to restart a current utility, and, if so, at what point the utility is to be restarted.

restart is an input parameter of type VARCHAR(8) in Unicode UTF-8, which must be translatable to allowable EBCDIC characters. Specify one of the following values for this parameter:

NO or null
Indicates that the utility job is new, not a restart. No other utility with the same utility identifier (UID) can exist.

The **default** is **null**.

CURRENT
Restarts the utility at the last commit point.

PHASE
Restarts the utility at the beginning of the currently stopped phase. Use the DISPLAY UTILITY to determine the currently stopped phase.

PREVIEW
Executes in PREVIEW mode the utility control statements that follow. While in PREVIEW mode, DB2 parses all utility control statements for syntax errors, but normal utility execution does not take place. If the syntax is valid, DB2 expands all LISTDEF lists and TEMPLATE data set name expressions that appear in SYSIN and prints the results to the SYSPRINT data set. DB2 evaluates and expands all LISTDEF definitions into an actual list of table spaces or index spaces. DB2 also evaluates TEMPLATE data set name expressions into actual data set names through variable substitution. DB2 also expands lists from the SYSLISTD DD and TEMPLATE data set name expressions from the SYSTEMPL DD that is referenced by a utility invocation.

Absence of the PREVIEW keyword turns off preview processing with one exception. The absence of this keyword does not override the PREVIEW JCL parameter which, if specified, remains in effect for the entire job step.

This option is identical to the PREVIEW JCL parameter.

utstmt
Specifies the utility control statements.

This is an input parameter of type VARCHAR(32704) in EBCDIC.

retcode
Specifies the utility highest return code.

This is an output parameter of type INTEGER.

utility-name
Specifies the utility that you want to invoke.

This is an input parameter of type VARCHAR(20) in EBCDIC.

Because DSNUTILS allows only a single utility here, dynamic support of data set allocation is limited. Specify only a single utility that requires data set allocation in the *utstmt* parameter.

Select the utility name from the following list:

ANY[1]

CHECK DATA

CHECK INDEX

CHECK LOB
COPY
COPYTOCOPY
DIAGNOSE
LOAD
MERGECOPY
MODIFY RECOVERY
MODIFY STATISTICS
QUIESCE
REBUILD INDEX
RECOVER
REORG INDEX
REORG LOB
REORG TABLESPACE
REPAIR
REPORT RECOVERY
REPORT TABLESPACESET
RUNSTATS INDEX
RUNSTATS TABLESPACE
STOSPACE
UNLOAD

1. Use ANY to indicate that TEMPLATE dynamic allocation is to be used. This value suppresses the dynamic allocation that is normally performed by DSNUTILS.

Recommendation: Invoke DSNUTILS with a *utility-name* of ANY and omit all of the *xxx*dsn, *xxx*devt, and *xxx*space parameters. Use TEMPLATE statements to allocate the data sets.

When you use TEMPLATE, utilities attempt to close and deallocate data sets when the utilities complete. However, under some circumstances, utilities cannot deallocate data sets. Under those circumstances, take one of the following sets of actions:

- If you want to terminate a utility after a failure:
  1. Use the TERM UTIL command to terminate the failing utility.
  2. Refresh the WLM environment in one of the following ways:
     - Submit the VARY command:
       ```
       VARY WLM,APPLENV=xxx,REFRESH
       ```
     - Call the WLM_REFRESH stored procedure.

  When you terminate the utility, DB2 deletes the data sets that are needed by the utility.
- If you want to restart a utility after a failure:
  1. Specify DISP (NEW,CATLG,CATLG) in your template for data sets that are needed by the utility.
  2. When the utility fails, refresh the WLM environment, but do not terminate the utility.

  You need to delete the allocated data sets manually after the utility completes.

recdsn
Specifies the cataloged data set name that is required by LOAD for input, or by REORG TABLESPACE as the unload data set. *recdsn* is required for LOAD. It is also required for REORG TABLESPACE unless you also specified NOSYSREC or SHRLEVEL CHANGE. If you specify *recdsn*, the data set is allocated to the SYSREC DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specified the INDDN parameter for LOAD, the specified *ddname* value **must** be SYSREC.

If you specify the UNLDDN parameter for REORG TABLESPACE, the specified *ddname* value **must** be SYSREC.

recdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *recdsn* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

recspace
Specifies the number of cylinders to use as the primary space allocation for the *recdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

discdsn
Specifies the cataloged data set name that is used by LOAD as a discard data set to hold records not loaded, and by REORG TABLESPACE as a discard data set to hold records that are not reloaded. If you specify *discdsn*, the data set is allocated to the SYSDISC DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the DISCARDDN parameter for LOAD or REORG TABLESPACE, the specified *ddname* value **must** be SYSDISC.

discdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *discdsn* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

discspace
Specifies the number of cylinders to use as the primary space allocation for the *discdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

pnchdsn
Specifies the cataloged data set name that REORG TABLESPACE UNLOAD EXTERNAL or REORG TABLESPACE DISCARD uses to hold the generated LOAD utility control statements. If you specify a value for *pnchdsn*, the data set is allocated to the SYSPUNCH DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the PUNCHDDN parameter for REORG TABLESPACE, the specified *ddname* value **must** be SYSPUNCH.

pnchdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *pnchdsn* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

pnchspace
Specifies the number of cylinders to use as the primary space allocation for the *pnchdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

copydsn1
Specifies the name of the required target (output) data set, which is needed when you specify the COPY, COPYTOCOPY, or MERGECOPY utilities. It is optional for LOAD and REORG TABLESPACE. If you specify *copydsn1*, the data set is allocated to the SYSCOPY DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the COPYDDN parameter for COPY, COPYTOCOPY, MERGECOPY, LOAD, or REORG TABLESPACE, the specified *ddname1* value **must** be SYSCOPY.

copydevt1
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *copydsn1* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

copyspace1
Specifies the number of cylinders to use as the primary space allocation for the *copydsn1* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

copydsn2
Specifies the name of the cataloged data set that is used as a target (output) data set for the backup copy. It is optional for COPY, COPYTOCOPY, MERGECOPY, LOAD, and REORG TABLESPACE. If you specify *copydsn2*, the data set is allocated to the SYSCOPY2 DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the COPYDDN parameter for COPY, COPYTOCOPY, MERGECOPY, LOAD, or REORG TABLESPACE, the specified *ddname2* value **must** be SYSCOPY2.

copydevt2
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *copydsn2* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

copyspace2
Specifies the number of cylinders to use as the primary space allocation for the *copydsn2* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

rcpydsn1
Specifies the name of the cataloged data set that is required as a target (output)

data set for the remote site primary copy. It is optional for COPY, COPYTOCOPY, LOAD, and REORG TABLESPACE. If you specify*rcpydsn1*, the data set is allocated to the SYSRCPY1 DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specified the RECOVERYDDN parameter for COPY, COPYTOCOPY, MERGECOPY, LOAD, or REORG TABLESPACE, the specified *ddname1* value **must** be SYSRCPY1.

rcpydevt1
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *rcpydsn1* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

rcpyspace1
Specifies the number of cylinders to use as the primary space allocation for the *rcpydsn1* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

rcpydsn2
Specifies the name of the cataloged data set that is required as a target (output) data set for the remote site backup copy. It is optional for COPY, COPYTOCOPY, LOAD, and REORG TABLESPACE. If you specify *rcpydsn2*, the data set is allocated to the **SYSRCPY2** DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the RECOVERYDDN parameter for COPY, COPYTOCOPY, MERGECOPY, LOAD, or REORG TABLESPACE, the specified *ddname2* value **must** be SYSRCPY2.

rcpydevt2
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *rcpydsn2* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

rcpyspace2
Specifies the number of cylinders to use as the primary space allocation for the *rcpydsn2* data set. The secondary space allocation is 10% of the primary space allocation

This is an input parameter of type SMALLINT.

workdsn1
Specifies the name of the cataloged data set that is required as a work data set for sort input and output. It is required for CHECK DATA, CHECK INDEX and REORG INDEX. It is also required for LOAD and REORG TABLESPACE unless you also specify the SORTKEYS keyword. It is optional for REBUILD INDEX. If you specify *workdsn1*, the data set is allocated to the SYSUT1 DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the WORKDDN parameter for CHECK DATA, CHECK INDEX, LOAD, REORG INDEX, REORG TABLESPACE, or REBUILD INDEX, the specified *ddname* value **must** be SYSUT1.

workdevt1
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *workdsn1* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

workspace1
Specifies the number of cylinders to use as the primary space allocation for the *workdsn1* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

workdsn2
Specifies the name of the cataloged data set that is required as a work data set for sort input and output. It is required for CHECK DATA. It is also required if you use REORG INDEX to reorganize non-unique type 1 indexes. It is required for LOAD or REORG TABLESPACE unless you also specify the SORTKEYS keyword. If you specify *workdsn2*, the data set is allocated to the SORTOUT DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the WORKDDN parameter for CHECK DATA, LOAD, REORG INDEX, or REORG TABLESPACE, the specified *ddname* value **must** be SORTOUT.

workdevt2
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *workdsn2* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

workspace2
Specifies the number of cylinders to use as the primary space allocation for the *workdsn2* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

mapdsn
Specifies the name of the cataloged data set that is required as a work data set for error processing during LOAD with ENFORCE CONSTRAINTS. It is optional for LOAD. If you specify *mapdsn*, the data set is allocated to the SYSMAP DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the MAPDDN parameter for LOAD, the specified *ddname* value **must** be SYSMAP.

mapdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *mapdsn* data set resides.

This is an input parameter of type CHAR(8).

mapspace
Specifies the number of cylinders to use as the primary space allocation for the *mapdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

errdsn
Specifies the name of the cataloged data set that is required as a work data set for error processing. It is required for CHECK DATA, and it is optional for LOAD. If you specify *errdsn*, the data set is allocated to the SYSERR DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the ERRDDN parameter for CHECK DATA or LOAD, the specified *ddname* value **must** be SYSERR.

errdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *errdsn* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

errspace
Specifies the number of cylinders to use as the primary space allocation for the *errdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

filtrdsn
Specifies the name of the cataloged data set that is required as a work data set for error processing. It is optional for COPY CONCURRENT. If you specify *filtrdsn*, the data set is allocated to the FILTER DD name.

This is an input parameter of type VARCHAR(54) in EBCDIC.

If you specify the FILTERDDN parameter for COPY, the specified *ddname* value **must** be FILTER.

filtrdevt
Specifies a unit address, a generic device type, or a user-assigned group name for a device on which the *filtrdsn* data set resides.

This is an input parameter of type CHAR(8) in EBCDIC.

filtrspace
Specifies the number of cylinders to use as the primary space allocation for the *filtrdsn* data set. The secondary space allocation is 10% of the primary space allocation.

This is an input parameter of type SMALLINT.

Modifying the WLM-established address space for DSNUTILS

Add DSSPRINT, SYSIN, and SYSPRINT to the JCL procedure for starting the WLM-established address space in which DSNUTILS runs.

Requirement: You must allocate SYSIN and SYSPRINT in the procedure to temporarily store utility input statements and utility output messages. If you plan to invoke RUNSTATS and collect distribution statistics, you also need to allocate RNPRIN01.

Use JCL similar to the following sample PROC:

```
//*************************************************************
//*    JCL FOR RUNNING THE WLM-ESTABLISHED STORED PROCEDURES
//*    ADDRESS SPACE
//*       RGN     -- THE MVS REGION SIZE FOR THE ADDRESS SPACE.
//*       DB2SSN  -- THE DB2 SUBSYSTEM NAME.
//*       APPLENV -- THE MVS WLM APPLICATION ENVIRONMENT
```

```
//*                  SUPPORTED BY THIS JCL PROCEDURE.
//*
//*    IMPORTANT: You must use the value 1 in this EXEC card:
//*       IEFPROC EXEC PGM=DSNX9WLM,REGION=&RGN,TIME=NOLIMIT,
//*       PARM='&DB2SSN,1,&APPLENV'
//*
//*************************************************************
//DSNWLM   PROC RGN=0K,APPLENV=WLMENV1,DB2SSN=DSN
//IEFPROC EXEC PGM=DSNX9WLM,REGION=&RGN,TIME=NOLIMIT,
//        PARM='&DB2SSN,1,&APPLENV'
//STEPLIB  DD  DISP=SHR,DSN=CEE.V!R!M!.SCEERUN
//         DD  DISP=SHR,DSN=DSN!!0.SDSNLOAD
//UTPRINT  DD  SYSOUT=*
//RNPRIN01 DD SYSOUT=*
//DSSPRINT DD  SYSOUT=*
//SYSIN    DD  UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
//SYSPRINT DD  UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND)
```

Sample program for calling DSNUTILS

Three example programs calling DSNUTILS are shipped in SDSNSAMP.

- DSNTEJ6U: A DSNUTILS caller that uses PL/I. Job DSNTEJ6U compiles, link-edits, binds, and runs sample PL/I program DSN8EPU, which invokes the DSNUTILS stored procedure to execute an utility.
- DSNTEJ6V: A DSNUTILS caller that uses C++. Job DSNTEJ6V compiles, link-edits, binds, and runs sample C++ program DSN8EE1, which invokes the DSNUTILS stored procedure to execute an utility.
- DSNTEJ80: A DSNUTILS caller that uses C and ODBC. You can use this sample to compile, pre-link, link-edit, and execute the sample application DSN8OIVP, which you can use to verify that your DB2 ODBC installation is correct.

DSNUTILS output

DB2 creates the result set according to the DECLARE statement that is shown under Example of declaring a cursor to select from SYSPRINT.

Output from a successful execution of the DSNTEJ6U sample job or an equivalent job lists the specified parameters followed by the messages that are generated by the DB2 DIAGNOSE DISPLAY MEPL utility.

If DSNUTILB abends, the abend codes are returned as DSNUTILS return codes.

Related reference:

DB2 Sort

Related information:

DFSORT Application Programming Guide

DSNUTILU stored procedure

Use the DSNUTILU stored procedure to run DB2 utilities from a DB2 application program.

When called, DSNUTILU performs the following actions:

- Translates the values that are specified for the *utility-id* and *restart* parameters to EBCDIC
- Creates the utility input stream (SYSIN) for utility control statements that are encoded in Unicode

- Invokes DB2 utilities by using DSNUTILB
- Deletes all the rows that are currently in the created temporary table (SYSIBM.SYSPRINT)
- Captures the utility output stream (SYSPRINT) into a created temporary table (SYSIBM.SYSPRINT)
- Declares a cursor to select from SYSPRINT:

```
DECLARE SYSPRINT CURSOR WITH RETURN FOR
  SELECT SEQNO, TEXT FROM SYSPRINT
  ORDER BY SEQNO;
```

- Opens the SYSPRINT cursor

The calling program then fetches rows from the returned result set to obtain the captured utility output.

The character set of the resulting utility SYPRINT output that is placed in the SYSIBM.SYSPRINT table is determined by the BIND PACKAGE statement for the DSNUTILU stored procedure. If the bind option ENCODING(EBCDIC) is specified, the SYSPRINT contents are in EBCDIC. If the bind option ENCODING(UNICODE) is specified, the SYSPRINT contents are in Unicode. The default installation job, DSNTIJRT, contains ENCODING(EBCDIC).

Environment for DSNUTILU

DSNUTILU must run in a WLM environment. You can use the WLM core environment DSNWLM_UTILS. DSNWLM_UTILS is intended for the DB2 utilities stored procedures DSNUTILS and DSNUTILU only. If you plan to run other applications in this environment, add the procedure and add the DCB information for SYSIN, as shown in the following example:

```
//SYSIN    DD    UNIT=SYSDA,SPACE=(4000,(20,20),,,ROUND),
//         DCB=(RECFM=V,LRECL=32708)
```

Related information:

Core WLM environments for DB2-supplied routines (DB2 Installation and Migration)

The WLM-established address space for DSNUTILU

The JCL procedure for starting the WLM-established address space in which DSNUTILU runs requires DD statements for DSSPRINT, SYSIN, and SYSPRINT. The SYSIN and SYSPRINT DD statements must allocate workfiles that DSNUTILU can use to temporarily store utility input statements and utility output messages. If you plan to run RUNSTATS and collect distribution statistics, you also need to allocate a DD statement for RNPRIN01.

DB2 provides an address space procedure for DSNWLM_UTILS, which is the core WLM environment for DSNUTILU. That address space procedure is called DSNWLMU. For detailed information about DSNWLMU, see Core WLM environments for DB2-supplied routines (DB2 Installation and Migration).

Authorization required for DSNUTILU

To call the DSNUTILU stored procedure, the owner of the package or plan that contains the CALL statement must have one or more of the following privileges on each package that the stored procedure uses:

- The EXECUTE privilege on the package for DSNUTILU

- Ownership of the package
- PACKADM authority for the package collection
- SYSADM authority

Then, to execute the utility, you must use a privilege set that includes the authorization to run the specified utility.

Utility control statements that are passed to DSNUTILU

Input data sets for the utility control statements can begin with the following Unicode characters:

- A Unicode UTF-8 blank (X'20')
- A Unicode UTF-8 dash (X'2D')
- Uppercase Unicode UTF-8 "A" through "Z" (X'41' through X'5A')

Any utility that requires a sort must include the SORTDEVT keyword in the utility control statement. Use of the SORTNUM keyword is optional.

Also, DSNUTILU does not dynamically allocate data sets. Use the TEMPLATE utility control statement to dynamically allocate data sets.

Related information:

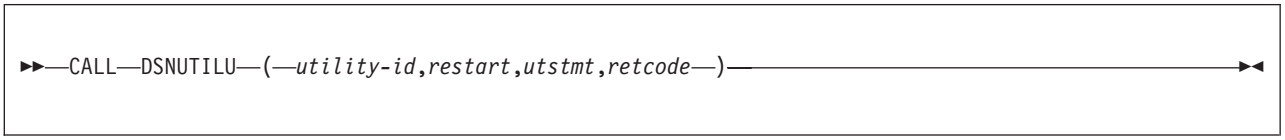
"Utility control statements" on page 22

DFSORT Application Programming Guide

DB2 Sort

DSNUTILU stored procedure syntax diagram

The following syntax diagram shows the SQL CALL statement for invoking utilities as a stored procedure.



DSNUTILU option descriptions

utility-id

Specifies a unique identifier for this utility within DB2.

utility-id is an input parameter of type VARCHAR(16) in Unicode UTF-8, which must be translatable to the following allowable EBCDIC characters:

- A - Z (uppercase and lowercase)
- 0 - 9
- #, $, @, ¢, !, ^, or period (.)

restart

Specifies whether DB2 is to restart a current utility, and, if so, at what point the utility is to be restarted.

restart is an input parameter of type VARCHAR(8) in Unicode UTF-8, which must be translatable to allowable EBCDIC characters. Specify one of the following values for this parameter:

NO or null
Indicates that the utility job is new and is not a restarted job. No other utility with the same utility identifier (UID) can exist.

The default is **null**.

CURRENT
Restarts the utility at the last commit point.

PHASE
Restarts the utility at the beginning of the currently stopped phase. Use the DISPLAY UTILITY command to determine the currently stopped phase.

PREVIEW
Executes the utility control statements that follow in preview mode.

In preview mode, DB2 parses all utility control statements for syntax errors, but normal utility execution does not occur. If the syntax is valid, DB2 expands all LISTDEF lists and TEMPLATE data set name expressions that are included in SYSIN and prints the results to the SYSPRINT data set. DB2 evaluates and expands all LISTDEF statements into a list of table spaces or index spaces. DB2 also evaluates TEMPLATE data set name expressions into data set names through variable substitution. DB2 also expands lists and data set name expressions from any LISTDEF libraries and TEMPLATE libraries that are referenced by a utility invocation.

If the PREVIEW keyword is omitted, preview processing is turned off with one exception. The absence of this keyword does not override the PREVIEW JCL parameter, which, if specified, remains in effect for the entire job step.

This option is identical to the PREVIEW JCL parameter.

Related information:

"Restarting an online utility" on page 52

-DISPLAY UTILITY (DB2) (DB2 Commands)

"Executing statements in preview mode" on page 411

utstmt
Specifies the utility control statements.

utstmt is an input parameter of type VARCHAR(32704) in Unicode UTF-8. If the utility statement is not in Unicode UTF-8, DB2 converts it to UTF-8. Therefore, if you pass a utility control statement in another format, consider the Possible consequences of character conversion (DB2 Internationalization Guide).

retcode
Specifies the utility highest return code.

retcode is an output parameter of type INTEGER.

Terminating or restarting a utility with DSNUTILU

If you do not want to restart a utility after a failure, take the following actions:

1. Use the TERM UTIL command to terminate the failing utility.

   When you terminate the utility, DB2 deletes the data sets that are needed by the utility.
2. Refresh the WLM environment in one of the following ways:
   - Submit the VARY command:

```
VARY WLM,APPLENV=xxx,REFRESH
```

- Call the WLM_REFRESH stored procedure.

If you want to restart a utility after a failure, take the following actions:

1. When you run the utility, use a TEMPLATE utility control statement, and specify DISP (NEW,CATLG,CATLG) in your template for data sets that are needed by the utility.
2. When the utility fails, refresh the WLM environment, but do not terminate the utility.
3. After the utility completes, delete the allocated data sets manually.

Related information:

WLM_REFRESH stored procedure (DB2 Application programming and SQL)

Sample program for calling DSNUTILU

The following sample program calls DSNUTILU and is included in SDSNSAMP:

Job DSNTEJ6R compiles, link-edits, binds, and runs sample C-language caller program DSN8ED8, which invokes the DSNUTILU stored procedure to execute a utility.

Related information:

Job DSNTEJ6R (DB2 Installation and Migration)

DSNUTILU output

DB2 creates the result set according to the DECLARE statement shown in Example of declaring a cursor to select from SYSPRINT

Output from a successful execution of the DSNTEJ6R sample job or an equivalent job lists the specified parameters, followed by the messages that are generated by the DB2 DIAGNOSE DISPLAY MEPL utility.

Related information:

"Syntax and options of the DIAGNOSE control statement" on page 209

DSNACCOR stored procedure (deprecated)

The DB2 real-time statistics stored procedure (DSNACCOR) is a sample stored procedure that makes recommendations to help you maintain your DB2 databases. The DSNACCOR stored procedure is deprecated. It is replaced by the DSNACCOX stored procedure.

DSNACCOX provides improved recommendations enhancements, enhanced fields, improved formulas, the ability to select the formula for recommendations, and more. For more information about DSNACCOX, see "DSNACCOX stored procedure" on page 1069

You can continue to use the DSNACCOR stored procedure. However, DSNACCOR is does not contain the enhancements that are found in the DSNACCOX stored procedure. DSNACCOR stored procedure is replaced by the DSNACCOX stored procedure.

In particular, DSNACCOR performs the following actions:

- Recommends when you should reorganize, image copy, or update statistics for table spaces or index spaces
- Indicates when a data set has exceeded a specified threshold for the number of extents that it occupies.
- Indicates whether objects are in a restricted state

DSNACCOR uses data from the SYSIBM.SYSTABLESPACESTATS and SYSIBM.SYSSYSINDEXSPACESTATS real-time statistics tables to make its recommendations. DSNACCOR provides its recommendations in a result set.

DSNACCOR uses the set of criteria that are shown in "DSNACCOR formulas for recommending actions" on page 1058 to evaluate table spaces and index spaces. By default, DSNACCOR evaluates **all** table spaces and index spaces in the subsystem that have entries in the real-time statistics tables. However, you can override this default through input parameters.

Important information about DSNACCOR recommendations:

- DSNACCOR makes recommendations based on general formulas that require input from the user about the maintenance policies for a subsystem. These recommendations might not be accurate for every installation.
- If the real-time statistics tables contain information for only a small percentage of your DB2 subsystem, the recommendations that DSNACCOR makes might not be accurate for the entire subsystem.
- Before you perform any action that DSNACCOR recommends, ensure that the object for which DSNACCOR makes the recommendation is available, and that the recommended action can be performed on that object. For example, before you can perform an image copy on an index, the index must have the COPY YES attribute.

Environment

DSNACCOR must run in a WLM-established stored procedure address space. The DSNWLM_GENERAL core WLM environment is a suitable environment for this stored procedure.

DSNACCOR is installed and configured by installation job DSNTIJRT, which binds the package for DSNACCOR with isolation UR to avoid lock contention.

Authorization required

To execute the CALL DSNACCOR statement, the owner of the package or plan that contains the CALL statement must have one or more of the following privileges on each package that the stored procedure uses:

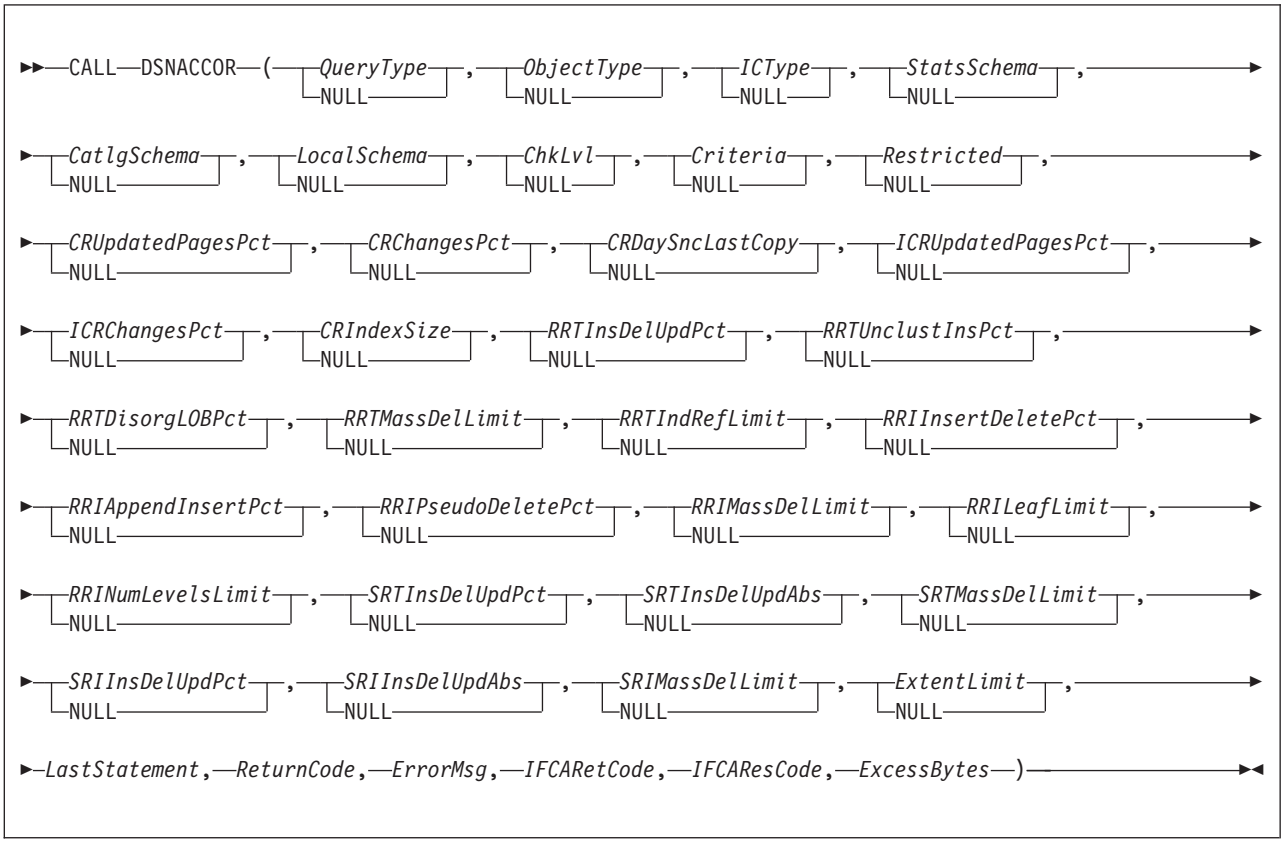
- The EXECUTE privilege on the package for DSNACCOR
- Ownership of the package
- PACKADM authority for the package collection
- SYSADM authority

The owner of the package or plan that contains the CALL statement must also have:

- SELECT authority on the real-time statistics tables
- Select authority on catalog tables
- The DISPLAY system privilege

Syntax diagram

The following syntax diagram shows the CALL statement for invoking DSNACCOR. Because the linkage convention for DSNACCOR is GENERAL WITH NULLS, if you pass parameters in host variables, you need to include a null indicator with every host variable. Null indicators for input host variables must be initialized before you execute the CALL statement.



Option descriptions

In the following option descriptions, the default value for an input parameter is the value that DSNACCOR uses if you specify a null value.

QueryType
Specifies the types of actions that DSNACCOR recommends. This field contains one or more of the following values. Each value is enclosed in single quotation marks and separated from other values by a space.

ALL Makes recommendations for all of the following actions.

COPY Makes a recommendation on whether to perform an image copy.

RUNSTATS
Makes a recommendation on whether to perform RUNSTATS.

REORG
Makes a recommendation on whether to perform REORG. Choosing this value causes DSNACCOR to process the EXTENTS value also.

EXTENTS
Indicates when data sets have exceeded a user-specified extents limit.

RESTRICT
Indicates which objects are in a restricted state.

QueryType is an input parameter of type VARCHAR(40). The default is **ALL**.

ObjectType
Specifies the types of objects for which DSNACCOR recommends actions:

ALL Table spaces and index spaces.

TS Table spaces only.

IX Index spaces only.

ObjectType is an input parameter of type VARCHAR(3). The default is **ALL**.

ICType
Specifies the types of image copies for which DSNACCOR is to make recommendations:

F Full image copy.

I Incremental image copy. This value is valid for table spaces only.

B Full image copy or incremental image copy.

ICType is an input parameter of type VARCHAR(1). The default is **B**.

StatsSchema
Specifies the qualifier for the real-time statistics table names. *StatsSchema* is an input parameter of type VARCHAR(128). The default is **SYSIBM**.

CatlgSchema
Specifies the qualifier for DB2 catalog table names. *CatlgSchema* is an input parameter of type VARCHAR(128). The default is **SYSIBM**.

LocalSchema
Specifies the qualifier for the names of tables that DSNACCOR creates. *LocalSchema* is an input parameter of type VARCHAR(128). The default is **DSNACC**.

ChkLvl
Specifies the types of checking that DSNACCOR performs, and indicates whether to include objects that fail those checks in the DSNACCOR recommendations result set. This value is the sum of any combination of the following values:

0 DSNACCOR performs none of the following actions.

1 For objects that are listed in the recommendations result set, check the SYSTABLESPACE or SYSINDEXES catalog tables to ensure that those objects have not been deleted. If value 16 is **not** also chosen, exclude rows for the deleted objects from the recommendations result set.

DSNACCOR excludes objects from the recommendations result set if those objects are not in the SYSTABLESPACE or SYSINDEXES catalog tables.

When this setting is specified, DSNACCOR does not use EXTENTS>*ExtentLimit* to determine whether a LOB table space should be reorganized.

2 For index spaces that are listed in the recommendations result set, check the SYSTABLES, SYSTABLESPACE, and SYSINDEXES catalog tables to determine the name of the table space that is associated with each index space.

Choosing this value causes DSNACCOR to also check for rows in the recommendations result set for objects that have been deleted but have entries in the real-time statistics tables (value 1). This means that if value 16 is **not** also chosen, rows for deleted objects are excluded from the recommendations result set.

4 Check whether rows that are in the DSNACCOR recommendations result set refer to objects that are in the exception table. For recommendations result set rows that have corresponding exception table rows, copy the contents of the QUERYTYPE column of the exception table to the INEXCEPTTABLE column of the recommendations result set.

8 Check whether objects that have rows in the recommendations result set are restricted. Indicate the restricted status in the OBJECTSTATUS column of the result set. A row is added to the result set for each object that has a restricted state, even if a row for the same object is already included in the result set because utility operations are recommended. So, the result set might contain duplicate rows for the same object when you specify this option.

16 For objects that are listed in the recommendations result set, check the SYSTABLESPACE or SYSINDEXES catalog tables to ensure that those objects have not been deleted (value 1). In result set rows for deleted objects, specify the word ORPHANED in the OBJECTSTATUS column.

32 Exclude rows from the DSNACCOR recommendations result set for index spaces for which the related table spaces have been recommended for REORG. Choosing this value causes DSNACCOR to perform the actions for values 1 and 2.

64 For index spaces that are listed in the DSNACCOR recommendations result set, check whether the related table spaces are listed in the exception table. For recommendations result set rows that have corresponding exception table rows, copy the contents of the QUERYTYPE column of the exception table to the INEXCEPTTABLE column of the recommendations result set.

ChkLvl is an input parameter of type INTEGER. The default is **7** (values 1+2+4).

Criteria
Narrows the set of objects for which DSNACCOR makes recommendations. This value is the search condition of an SQL WHERE clause. *Criteria* is an input parameter of type VARCHAR(4096). The default is that DSNACCOR makes recommendations for all table spaces and index spaces in the subsystem. The search condition can use any column in the result set and wildcards are allowed.

Restricted
A parameter that is reserved for future use. Specify the null value for this parameter. *Restricted* is an input parameter of type VARCHAR(80).

CRUpdatedPagesPct
Specifies a criterion for recommending a full image copy on a table space or index space. If the following condition is true for a table space, DSNACCOR recommends an image copy:

> The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct.*

See item 2 in Figure 141 on page 1059. If both of the following conditions are true for an index space, DSNACCOR recommends an image copy:

- The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct.*
- The number of active pages in the index space or partition is greater than *CRIndexSize*. See items 2 and 3 in Figure 142 on page 1059.

CRUpdatedPagesPct is an input parameter of type INTEGER. The default is **20**.

CRChangesPct
Specifies a criterion for recommending a full image copy on a table space or index space. If the following condition is true for a table space, DSNACCOR recommends an image copy:

> The total number of insert, update, and delete operations since the last image copy, divided by the total number of rows or LOBs in a table space or partition (expressed as a percentage) is greater than *CRChangesPct.*

See item 3 in Figure 141 on page 1059. If both of the following conditions are true for an index table space, DSNACCOR recommends an image copy:

- The total number of insert and delete operations since the last image copy, divided by the total number of entries in the index space or partition (expressed as a percentage) is greater than *CRChangesPct*.
- The number of active pages in the index space or partition is greater than *CRIndexSize.*

See items 2 and 4 in Figure 142 on page 1059. *CRChangesPct* is an input parameter of type INTEGER. The default is **10**.

CRDaySncLastCopy
Specifies a criterion for recommending a full image copy on a table space or index space. If the number of days since the last image copy is greater than this value, DSNACCOR recommends an image copy. (See item 1 in Figure 141 on page 1059 and item 1 in Figure 142 on page 1059.) *CRDaySncLastCopy* is an input parameter of type INTEGER. The default is **7**.

ICRUpdatedPagesPct
Specifies a criterion for recommending an incremental image copy on a table space. If the following condition is true, DSNACCOR recommends an incremental image copy:

> The number of distinct pages that were updated since the last image copy, divided by the total number of active pages in the table space or partition (expressed as a percentage) is greater than *CRUpdatedPagesPct.*

(See item 1 in Figure 143 on page 1059.) *ICRUpdatedPagesPct* is an input parameter of type INTEGER. The default is **1**.

ICRChangesPct
Specifies a criterion for recommending an incremental image copy on a table space. If the following condition is true, DSNACCOR recommends an incremental image copy:

The ratio of the number of insert, update, or delete operations since the last image copy, to the total number of rows or LOBs in a table space or partition (expressed as a percentage) is greater than *ICRChangesPct*.

(See item 2 in Figure 143 on page 1059.) *ICRChangesPct* is an input parameter of type INTEGER. The default is **1**.

CRIndexSize
Specifies, when combined with *CRUpdatedPagesPct* or *CRChangesPct*, a criterion for recommending a full image copy on an index space. (See items 2, 3, and 4 in Figure 142 on page 1059.) *CRIndexSize* is an input parameter of type INTEGER. The default is **50**.

RRTInsDelUpdPct
Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOR recommends running REORG:

The sum of insert, update, and delete operations since the last REORG, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTInsDelUpdPct*

(See item 1 in Figure 144 on page 1060.) *RRTInsDelUpdPct* is an input parameter of type INTEGER. The default is **20**.

RRTUnclustInsPct
Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOR recommends running REORG:

The number of unclustered insert operations, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTUnclustInsPct*.

(See item 2 in Figure 144 on page 1060.) *RRTUnclustInsPct* is an input parameter of type INTEGER. The default is **10**.

RRTDisorgLOBPct
Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOR recommends running REORG:

The number of imperfectly chunked LOBs, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTDisorgLOBPct*.

(See item 3 in Figure 144 on page 1060.) *RRTDisorgLOBPct* is an input parameter of type INTEGER. The default is **10**.

RRTMassDelLimit
Specifies a criterion for recommending that the REORG utility is to be run on a table space. If one of the following values is greater than *RRTMassDelLimit*, DSNACCOR recommends running REORG:

- The number of mass deletes from a segmented or LOB table space since the last REORG or LOAD REPLACE
- The number of dropped tables from a nonsegmented table space since the last REORG or LOAD REPLACE

(See item 5 in Figure 144 on page 1060.) *RRTMassDelLimit* is an input parameter of type INTEGER. The default is **0**.

RRTIndRefLimit
Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following value is greater than *RRTIndRefLimit*, DSNACCOR recommends running REORG:

The total number of overflow records that were created since the last REORG or LOAD REPLACE, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage)

(See item 4 in Figure 144 on page 1060.) *RRTIndRefLimit* is an input parameter of type INTEGER. The default is **10**.

RRIInsertDeletePct
Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIInsertDeletePct*, DSNACCOR recommends running REORG:

The sum of the number of index entries that were inserted and deleted since the last REORG, divided by the total number of index entries in the index space or partition (expressed as a percentage)

(See item 1 in Figure 145 on page 1060.) This is an input parameter of type INTEGER. The default is **20**.

RRIAppendInsertPct
Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIAppendInsertPct*, DSNACCOR recommends running REORG:

The number of index entries that were inserted since the last REORG, REBUILD INDEX, or LOAD REPLACE with a key value greater than the maximum key value in the index space or partition, divided by the number of index entries in the index space or partition (expressed as a percentage)

(See item 2 in Figure 145 on page 1060.) *RRIInsertDeletePct* is an input parameter of type INTEGER. The default is **10**.

RRIPseudoDeletePct
Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIPseudoDeletePct*, DSNACCOR recommends running REORG:

The number of index entries that were pseudo-deleted since the last REORG, REBUILD INDEX, or LOAD REPLACE, divided by the number of index entries in the index space or partition (expressed as a percentage)

(See item 3 in Figure 145 on page 1060.) *RRIPseudoDeletePct* is an input parameter of type INTEGER. The default is **10**.

RRIMassDelLimit
Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the number of mass deletes from an index space or partition since the last REORG, REBUILD, or LOAD REPLACE is greater than this value, DSNACCOR recommends running REORG.

(See item 4 in Figure 145 on page 1060.) *RRIMassDelLimit* is an input parameter of type INTEGER. The default is **0**.

RRILeafLimit
Specifies a criterion for recommending that the REORG utility is to be run on

an index space. If the following value is greater than *RRILeafLimit*, DSNACCOR recommends running REORG:

The number of index page splits that occurred since the last REORG, REBUILD INDEX, or LOAD REPLACE that resulted in a large separation between the parts of the original page, divided by the total number of active pages in the index space or partition (expressed as a percentage)

(See item 5 in Figure 145 on page 1060.) *RRILeafLimit* is an input parameter of type INTEGER. The default is **10**.

RRINumLevelsLimit
Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRINumLevelsLimit*, DSNACCOR recommends running REORG:

The number of levels in the index tree that were added or removed since the last REORG, REBUILD INDEX, or LOAD REPLACE

(See item 6 in Figure 145 on page 1060.) *RRINumLevelsLimit* is an input parameter of type INTEGER. The default is **0**.

SRTInsDelUpdPct
Specifies, when combined with *SRTInsDelUpdAbs*, a criterion for recommending that the RUNSTATS utility is to be run on a table space. If both of the following conditions are true, DSNACCOR recommends running RUNSTATS:

- The number of insert, update, or delete operations since the last RUNSTATS on a table space or partition, divided by the total number of rows or LOBs in table space or partition (expressed as a percentage) is greater than *SRTInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRTInsDelUpdAbs.*

(See items 1 and 2 in Figure 146 on page 1060.) *SRTInsDelUpdPct* is an input parameter of type INTEGER. The default is **20**.

SRTInsDelUpdAbs
Specifies, when combined with *SRTInsDelUpdPct*, a criterion for recommending that the RUNSTATS utility is to be run on a table space. If both of the following conditions are true, DSNACCOR recommends running RUNSTATS:

- The number of insert, update, and delete operations since the last RUNSTATS on a table space or partition, divided by the total number of rows or LOBs in table space or partition (expressed as a percentage) is greater than *SRTInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRTInsDelUpdAbs.*

(See items 1 and 2 in Figure 146 on page 1060.) *SRTInsDelUpdAbs* is an input parameter of type INTEGER. The default is **0**.

SRTMassDelLimit
Specifies a criterion for recommending that the RUNSTATS utility is to be run on a table space. If the following condition is true, DSNACCOR recommends running RUNSTATS:

- The number of mass deletes from a table space or partition since the last REORG or LOAD REPLACE is greater than *SRTMassDelLimit.*

(See item 3 in Figure 146 on page 1060.) *SRTMassDelLimit* is an input parameter of type INTEGER. The default is **0**.

SRIInsDelUpdPct
Specifies, when combined with *SRIInsDelUpdAbs*, a criterion for recommending that the RUNSTATS utility is to be run on an index space. If both of the following conditions are true, DSNACCOR recommends running RUNSTATS:

- The number of inserted and deleted index entries since the last RUNSTATS on an index space or partition, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *SRIInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRIInsDelUpdAbs.*

(See items 1 and 2 in Figure 147 on page 1060.) *SRIInsDelUpdPct* is an input parameter of type INTEGER. The default is **20**.

SRIInsDelUpdAbs
Specifies, when combined with *SRIInsDelUpdPct*, a criterion for recommending that the RUNSTATS utility is to be run on an index space. If the following condition is true, DSNACCOR recommends running RUNSTATS:

- The number of inserted and deleted index entries since the last RUNSTATS on an index space or partition, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *SRIInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRIInsDelUpdAbs*,

(See items 1 and 2 in Figure 147 on page 1060.) *SRIInsDelUpdAbs* is an input parameter of type INTEGER. The default is **0**.

SRIMassDelLimit
Specifies a criterion for recommending that the RUNSTATS utility is to be run on an index space. If the number of mass deletes from an index space or partition since the last REORG, REBUILD INDEX, or LOAD REPLACE is greater than this value, DSNACCOR recommends running RUNSTATS.

(See item 3 in Figure 147 on page 1060.) *SRIMassDelLimit* is an input parameter of type INTEGER. The **default** is **0**.

ExtentLimit
Specifies a criterion for recommending that the REORG utility is to be run on a table space or index space. Also specifies that DSNACCOR is to warn the user that the table space or index space has used too many extents. DSNACCOR recommends running REORG, and altering data set allocations if the following condition is true:

- The number of physical extents in the index space, table space, or partition is greater than *ExtentLimit.*

(See Figure 148 on page 1061.) *ExtentLimit* is an input parameter of type INTEGER. The default is **50**.

LastStatement
When DSNACCOR returns a severe error (return code 12), this field contains the SQL statement that was executing when the error occurred. *LastStatement* is an output parameter of type VARCHAR(8012).

ReturnCode
The return code from DSNACCOR execution. Possible values are:

0 DSNACCOR executed successfully. The *ErrorMsg* parameter contains the approximate percentage of the total number of objects in the subsystem that have information in the real-time statistics tables.

4 DSNACCOR completed, but one or more input parameters might be incompatible. The *ErrorMsg* parameter contains the input parameters that might be incompatible.

8 DSNACCOR terminated with errors. The *ErrorMsg* parameter contains a message that describes the error.

12 DSNACCOR terminated with severe errors. The *ErrorMsg* parameter contains a message that describes the error. The *LastStatement* parameter contains the SQL statement that was executing when the error occurred.

14 DSNACCOR terminated because it could not access one or more of the real-time statistics tables. The *ErrorMsg* parameter contains the names of the tables that DSNACCOR could not access.

15 DSNACCOR terminated because it encountered a problem with one of the declared temporary tables that it defines and uses.

16 DSNACCOR terminated because it could not define a declared temporary table. No table spaces were defined in the TEMP database.

NULL DSNACCOR terminated but could not set a return code.

ReturnCode is an output parameter of type INTEGER.

ErrorMsg
Contains information about DSNACCOR execution. If DSNACCOR runs successfully (*ReturnCode*=0), this field contains the approximate percentage of objects in the subsystem that are in the real-time statistics tables. Otherwise, this field contains error messages. *ErrorMsg* is an output parameter of type VARCHAR(1331).

IFCARetCode
Contains the return code from an IFI COMMAND call. DSNACCOR issues commands through the IFI interface to determine the status of objects. *IFCARetCode* is an output parameter of type INTEGER.

IFCAResCode
Contains the reason code from an IFI COMMAND call. *IFCAResCode* is an output parameter of type INTEGER.

ExcessBytes
Contains the number of bytes of information that did not fit in the IFI return area after an IFI COMMAND call. *ExcessBytes* is an output parameter of type INTEGER.

DSNACCOR formulas for recommending actions

The following formulas specify the criteria that DSNACCOR uses for its recommendations and warnings. The variables in italics are DSNACCOR input parameters. The capitalized variables are columns of the SYSIBM.SYSTABLESPACESTATS or SYSIBM.SYSINDEXSPACESTATS tables. The numbers to the right of selected items are reference numbers for the option descriptions in "Option descriptions" on page 1050.

The figure below shows the formula that DSNACCOR uses to recommend a full image copy on a table space.

```
((QueryType='COPY' OR QueryType='ALL') AND
 (ObjectType='TS' OR ObjectType='ALL') AND
 ICType='F') AND
 (COPYLASTTIME IS NULL OR
 REORGLASTTIME>COPYLASTTIME OR
 LOADRLASTTIME>COPYLASTTIME OR
 (CURRENT DATE-COPYLASTTIME)>CRDaySncLastCopy OR      1
 (COPYUPDATEDPAGES*100)/NACTIVE>CRUpdatedPagesPct OR  2
 (COPYCHANGES*100)/TOTALROWS>CRChangesPct)            3
```

Figure 141. DSNACCOR formula for recommending a full image copy on a table space

The figure below shows the formula that DSNACCOR uses to recommend a full image copy on an index space.

```
((QueryType='COPY' OR QueryType='ALL') AND
 (ObjectType='IX' OR ObjectType='ALL') AND
 (ICType='F'  OR ICType='B')) AND
 (COPYLASTTIME IS NULL OR
 REORGLASTTIME>COPYLASTTIME OR
 LOADRLASTTIME>COPYLASTTIME OR
 REBUILDLASTTIME>COPYLASTTIME OR
 (CURRENT DATE-COPYLASTTIME)>CRDaySncLastCopy OR      1
 (NACTIVE>CRIndexSize AND                             2
 ((COPYUPDATEDPAGES*100)/NACTIVE>CRUpdatedPagesPct OR 3
 (COPYCHANGES*100)/TOTALENTRIES>CRChangesPct)))       4
```

Figure 142. DSNACCOR formula for recommending a full image copy on an index space

The figure below shows the formula that DSNACCOR uses to recommend an incremental image copy on a table space.

```
((QueryType='COPY' OR QueryType='ALL') AND
 (ObjectType='TS' OR ObjectType='ALL') AND
 ICType='I' AND
 COPYLASTTIME IS NOT NULL) AND
 (LOADRLASTTIME>COPYLASTTIME OR
 REORGLASTTIME>COPYLASTTIME OR
 (COPYUPDATEDPAGES*100)/NACTIVE>ICRUpdatedPagesPct OR 1
 (COPYCHANGES*100)/TOTALROWS>ICRChangesPct))          2
```

Figure 143. DSNACCOR formula for recommending an incremental image copy on a table space

The figure below shows the formula that DSNACCOR uses to recommend a REORG on a table space. If the table space is a LOB table space, and CHCKLVL=1, the formula does not include EXTENTS>*ExtentLimit*.

```
((QueryType='REORG' OR QueryType='ALL') AND
 (ObjectType='TS' OR ObjectType='ALL')) AND
 (REORGLASTTIME IS NULL OR
 ((REORGINSERTS+REORGDELETES+REORGUPDATES)*100)/TOTALROWS>RRTInsDelUpdPct OR  1
 (REORGUNCLUSTINS*100)/TOTALROWS>RRTUnclustInsPct OR                          2
 (REORGDISORGLOB*100)/TOTALROWS>RRTDisorgLOBPct OR                            3
 ((REORGNEARINDREF+REORGFARINDREF)*100)/TOTALROWS>RRTIndRefLimit OR            4
 REORGMASSDELETE>RRTMassDelLimit OR                                           5
 EXTENTS>ExtentLimit)                                                         6
```

Figure 144. DSNACCOR formula for recommending a REORG on a table space

The figure below shows the formula that DSNACCOR uses to recommend a REORG on an index space.

```
((QueryType='REORG' OR QueryType='ALL') AND
 (ObjectType='IX' OR ObjectType='ALL')) AND
 (REORGLASTTIME IS NULL OR
 ((REORGINSERTS+REORGDELETES)*100)/TOTALENTRIES>RRIInsertDeletePct OR        1
 (REORGAPPENDINSERT*100)/TOTALENTRIES>RRIAppendInsertPct OR                  2
 (REORGPSEUDODELETES*100)/TOTALENTRIES>RRIPseudoDeletePct OR                 3
 REORGMASSDELETE>RRIMassDeleteLimit OR                                       4
 (REORGLEAFFAR*100)/NACTIVE>RRILeafLimit OR                                  5
 REORGNUMLEVELS>RRINumLevelsLimit OR                                         6
 EXTENTS>ExtentLimit)                                                        7
```

Figure 145. DSNACCOR formula for recommending a REORG on an index space

The figure below shows the formula that DSNACCOR uses to recommend RUNSTATS on a table space.

```
((QueryType='RUNSTATS' OR QueryType='ALL') AND
 (ObjectType='TS' OR ObjectType='ALL')) AND
 (STATSLASTTIME IS NULL OR
 (((STATSINSERTS+STATSDELETES+STATSUPDATES)*100)/TOTALROWS>SRTInsDelUpdPct AND  1
 (STATSINSERTS+STATSDELETES+STATSUPDATES)>SRTInsDelUpdAbs) OR                    2
 STATSMASSDELETE>SRTMassDeleteLimit)                                            3
```

Figure 146. DSNACCOR formula for recommending RUNSTATS on a table space

The figure below shows the formula that DSNACCOR uses to recommend RUNSTATS on an index space.

```
((QueryType='RUNSTATS' OR QueryType='ALL') AND
 (ObjectType='IX' OR ObjectType='ALL')) AND
 (STATSLASTTIME IS NULL OR
 (((STATSINSERTS+STATSDELETES)*100)/TOTALENTRIES>SRIInsDelUpdPct AND  1
 (STATSINSERTS+STATSDELETES)>SRIInsDelUpdPct) OR                      2
 STATSMASSDELETE>SRIInsDelUpdAbs)                                     3
```

Figure 147. DSNACCOR formula for recommending RUNSTATS on an index space

The figure below shows the formula that DSNACCOR uses to that too many index space or table space extents have been used.

```
EXTENTS>ExtentLimit
```

Figure 148. DSNACCOR formula for warning that too many data set extents for a table space or index space are used

Using an exception table

An exception table is an optional, user-created DB2 table that you can use to place information in the INEXCEPTTABLE column of the recommendations result set. You can put any information in the INEXCEPTTABLE column, but the most common use of this column is to filter the recommendations result set. Each row in the exception table represents an object for which you want to provide information for the recommendations result set.

To create the exception table, execute a CREATE TABLE statement similar to the following one. You can include other columns in the exception table, but you must include at least the columns that are shown.

```
CREATE TABLE DSNACC.EXCEPT_TBL
 (DBNAME CHAR(8) NOT NULL,
  NAME CHAR(8) NOT NULL,
  QUERYTYPE CHAR(40))
 CCSID EBCDIC;
```

The meanings of the columns are:

DBNAME
The database name for an object in the exception table.

NAME
The table space name or index space name for an object in the exception table.

QUERYTYPE
The information that you want to place in the INEXCEPTTABLE column of the recommendations result set.

If you put a null value in this column, DSNACCOR puts the value YES in the INEXCEPTTABLE column of the recommendations result set row for the object that matches the DBNAME and NAME values.

Recommendation: If you plan to put many rows in the exception table, create a nonunique index on DBNAME, NAME, and QUERYTYPE.

After you create the exception table, insert a row for each object for which you want to include information in the INEXCEPTTABLE column.

Example: Suppose that you want the INEXCEPTTABLE column to contain the string 'IRRELEVANT' for table space STAFF in database DSNDB04. You also want the INEXCEPTTABLE column to contain 'CURRENT' for table space DSN8S11D in database DSN8D11A. Execute these INSERT statements:

```
INSERT INTO DSNACC.EXCEPT_TBL VALUES('DSNDB04 ', 'STAFF ', 'IRRELEVANT');
INSERT INTO DSNACC.EXCEPT_TBL VALUES('DSN8D11A', 'DSN8S11D', 'CURRENT');
```

To use the contents of INEXCEPTTABLE for filtering, include a condition that involves the INEXCEPTTABLE column in the search condition that you specify in your *Criteria* input parameter.

Example: Suppose that you want to include all rows for database DSNDB04 in the recommendations result set, except for those rows that contain the string

'IRRELEVANT' in the INEXCEPTTABLE column. You might include the following search condition in your *Criteria* input parameter:

```
DBNAME='DSNDB04' AND INEXCEPTTABLE<>'IRRELEVANT'
```

Example

The following COBOL example that shows variable declarations and an SQL CALL for obtaining recommendations for objects in databases DSN8D11A and DSN8D11L. This example also outlines the steps that you need to perform to retrieve the two result sets that DSNACCOR returns.

```
 WORKING-STORAGE SECTION.
⋮
**********************
* DSNACCOR PARAMETERS *
**********************
 01  QUERYTYPE.
     49   QUERYTYPE-LN        PICTURE S9(4) COMP VALUE 40.
     49   QUERYTYPE-DTA       PICTURE X(40)  VALUE 'ALL'.
 01  OBJECTTYPE.
     49   OBJECTTYPE-LN       PICTURE S9(4) COMP VALUE 3.
     49   OBJECTTYPE-DTA      PICTURE X(3)  VALUE 'ALL'.
 01  ICTYPE.
     49   ICTYPE-LN           PICTURE S9(4) COMP VALUE 1.
     49   ICTYPE-DTA          PICTURE X(1)  VALUE 'B'.
 01  STATSSCHEMA.
     49   STATSSCHEMA-LN      PICTURE S9(4) COMP VALUE 128.
     49   STATSSCHEMA-DTA     PICTURE X(128)  VALUE 'SYSIBM'.
 01  CATLGSCHEMA.
 49   CATLGSCHEMA-LN      PICTURE S9(4) COMP VALUE 128.
     49   CATLGSCHEMA-DTA     PICTURE X(128)  VALUE 'SYSIBM'.
 01  LOCALSCHEMA.
     49   LOCALSCHEMA-LN      PICTURE S9(4) COMP VALUE 128.
     49   LOCALSCHEMA-DTA     PICTURE X(128)  VALUE 'DSNACC'.
 01  CHKLVL                   PICTURE S9(9) COMP VALUE +3.
 01  CRITERIA.
     49   CRITERIA-LN         PICTURE S9(4) COMP VALUE 4096.
     49   CRITERIA-DTA        PICTURE X(4096)  VALUE SPACES.
 01  RESTRICTED.
     49   RESTRICTED-LN       PICTURE S9(4) COMP VALUE 80.
     49   RESTRICTED-DTA      PICTURE X(80)  VALUE SPACES.
 01  CRUPDATEDPAGESPCT        PICTURE S9(9) COMP VALUE +0.
 01  CRCHANGESPCT             PICTURE S9(9) COMP VALUE +0.
 01  CRDAYSNCLASTCOPY         PICTURE S9(9) COMP VALUE +0.
 01  ICRUPDATEDPAGESPCT       PICTURE S9(9) COMP VALUE +0.
 01  ICRCHANGESPCT            PICTURE S9(9) COMP VALUE +0.
 01  CRINDEXSIZE              PICTURE S9(9) COMP VALUE +0.
 01  RRTINSDELUPDPCT          PICTURE S9(9) COMP VALUE +0.
 01  RRTUNCLUSTINSPCT         PICTURE S9(9) COMP VALUE +0.
 01  RRTDISORGLOBPCT          PICTURE S9(9) COMP VALUE +0.
 01  RRTMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  RRTINDREFLIMIT           PICTURE S9(9) COMP VALUE +0.
 01  RRIINSERTDELETEPCT       PICTURE S9(9) COMP VALUE +0.
 01  RRIAPPENDINSERTPCT       PICTURE S9(9) COMP VALUE +0.
 01  RRIPSEUDODELETEPCT       PICTURE S9(9) COMP VALUE +0.
 01  RRIMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  RRILEAFLIMIT             PICTURE S9(9) COMP VALUE +0.
 01  RRINUMLEVELSLIMIT        PICTURE S9(9) COMP VALUE +0.
 01  SRTINSDELUPDPCT          PICTURE S9(9) COMP VALUE +0.
 01  SRTINSDELUPDABS          PICTURE S9(9) COMP VALUE +0.
 01  SRTMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  SRIINSDELUPDPCT          PICTURE S9(9) COMP VALUE +0.
 01  SRIINSDELUPDABS          PICTURE S9(9) COMP VALUE +0.
 01  SRIMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  EXTENTLIMIT              PICTURE S9(9) COMP VALUE +0.
```

```
 01  LASTSTATEMENT.
     49   LASTSTATEMENT-LN    PICTURE S9(4) COMP VALUE 8012.
     49   LASTSTATEMENT-DTA   PICTURE X(8012)  VALUE SPACES.
 01  RETURNCODE              PICTURE S9(9) COMP VALUE +0.
 01  ERRORMSG.
     49   ERRORMSG-LN         PICTURE S9(4) COMP VALUE 1331.
     49   ERRORMSG-DTA        PICTURE X(1331)  VALUE SPACES.
 01  IFCARETCODE             PICTURE S9(9) COMP VALUE +0.
 01  IFCARESCODE             PICTURE S9(9) COMP VALUE +0.
 01  EXCESSBYTES             PICTURE S9(9) COMP VALUE +0.
*****************************************
* INDICATOR VARIABLES.                  *
* INITIALIZE ALL NON-ESSENTIAL INPUT    *
* VARIABLES TO -1, TO INDICATE THAT THE *
* INPUT VALUE IS NULL.                  *
*****************************************
 01  QUERYTYPE-IND           PICTURE S9(4) COMP-4 VALUE +0.
 01  OBJECTTYPE-IND          PICTURE S9(4) COMP-4 VALUE +0.
 01  ICTYPE-IND              PICTURE S9(4) COMP-4 VALUE +0.
 01  STATSSCHEMA-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  CATLGSCHEMA-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  LOCALSCHEMA-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  CHKLVL-IND              PICTURE S9(4) COMP-4 VALUE -1.
 01  CRITERIA-IND            PICTURE S9(4) COMP-4 VALUE -1.
 01  RESTRICTED-IND          PICTURE S9(4) COMP-4 VALUE -1.
 01  CRUPDATEDPAGESPCT-IND   PICTURE S9(4) COMP-4 VALUE -1.
 01  CRCHANGESPCT-IND        PICTURE S9(4) COMP-4 VALUE -1.
 01  CRDAYSNCLASTCOPY-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  ICRUPDATEDPAGESPCT-IND  PICTURE S9(4) COMP-4 VALUE -1.
 01  ICRCHANGESPCT-IND       PICTURE S9(4) COMP-4 VALUE -1.
 01  CRINDEXSIZE-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTINSDELUPDPCT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTUNCLUSTINSPCT-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTDISORGLOBPCT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTMASSDELLIMIT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTINDREFLIMIT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIINSERTDELETEPCT-IND  PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIAPPENDINSERTPCT-IND  PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIPSEUDODELETEPCT-IND  PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIMASSDELLIMIT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  RRILEAFLIMIT-IND        PICTURE S9(4) COMP-4 VALUE -1.
 01  RRINUMLEVELSLIMIT-IND   PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTINSDELUPDPCT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTINSDELUPDABS-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTMASSDELLIMIT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  SRIINSDELUPDPCT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  SRIINSDELUPDABS-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  SRIMASSDELLIMIT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  EXTENTLIMIT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  LASTSTATEMENT-IND       PICTURE S9(4) COMP-4 VALUE +0.
 01  RETURNCODE-IND          PICTURE S9(4) COMP-4 VALUE +0.
 01  ERRORMSG-IND            PICTURE S9(4) COMP-4 VALUE +0.
 01  IFCARETCODE-IND         PICTURE S9(4) COMP-4 VALUE +0.
 01  IFCARESCODE-IND         PICTURE S9(4) COMP-4 VALUE +0.
 01  EXCESSBYTES-IND         PICTURE S9(4) COMP-4 VALUE +0.

 PROCEDURE DIVISION.
:
:
*********************************************************
* SET VALUES FOR DSNACCOR INPUT PARAMETERS:             *
* - USE THE CHKLVL PARAMETER TO CAUSE DSNACCOR TO CHECK *
*   FOR ORPHANED OBJECTS AND INDEX SPACES WITHOUT       *
*   TABLE SPACES, BUT INCLUDE THOSE OBJECTS IN THE      *
*   RECOMMENDATIONS RESULT SET (CHKLVL=1+2+16=19)       *
* - USE THE CRITERIA PARAMETER TO CAUSE DSNACCOR TO     *
*   MAKE RECOMMENDATIONS ONLY FOR OBJECTS IN DATABASES  *
*   DSN8D11A AND DSN8D11L.                              *
```

```
* - FOR THE FOLLOWING PARAMETERS, SET THESE VALUES,     *
*   WHICH ARE LOWER THAN THE DEFAULTS:                  *
*   CRUPDATEDPAGESPCT   4                               *
*   CRCHANGESPCT        2                               *
*   RRTINSDELUPDPCT     2                               *
*   RRTUNCLUSTINSPCT    5                               *
*   RRTDISORGLOBPCT     5                               *
*   RRIAPPENDINSERTPCT  5                               *
*   SRTINSDELUPDPCT     5                               *
*   SRIINSDELUPDPCT     5                               *
*   EXTENTLIMIT         3                               *
*********************************************************
     MOVE 19 TO CHKLVL.
     MOVE SPACES TO CRITERIA-DTA.
     MOVE 'DBNAME = ''DSN8D11A'' OR DBNAME = ''DSN8D11L'''
           TO CRITERIA-DTA.
     MOVE 46 TO CRITERIA-LN.
     MOVE 4 TO CRUPDATEDPAGESPCT.
     MOVE 2 TO CRCHANGESPCT.
     MOVE 2 TO RRTINSDELUPDPCT.
     MOVE 5 TO RRTUNCLUSTINSPCT.
     MOVE 5 TO RRTDISORGLOBPCT.
     MOVE 5 TO RRIAPPENDINSERTPCT.
     MOVE 5 TO SRTINSDELUPDPCT.
     MOVE 5 TO SRIINSDELUPDPCT.
     MOVE 3 TO EXTENTLIMIT.
*******************************
* INITIALIZE OUTPUT PARAMETERS *
*******************************
     MOVE SPACES TO LASTSTATEMENT-DTA.
     MOVE 1 TO LASTSTATEMENT-LN.
     MOVE 0 TO RETURNCODE-O2.
     MOVE SPACES TO ERRORMSG-DTA.
     MOVE 1 TO ERRORMSG-LN.
     MOVE 0 TO IFCARETCODE.
     MOVE 0 TO IFCARESCODE.
     MOVE 0 TO EXCESSBYTES.
*********************************************************
* SET THE INDICATOR VARIABLES TO 0 FOR NON-NULL INPUT *
* PARAMETERS (PARAMETERS FOR WHICH YOU DO NOT WANT    *
* DSNACCOR TO USE DEFAULT VALUES) AND FOR OUTPUT      *
* PARAMETERS.                                         *
*********************************************************
     MOVE 0 TO CHKLVL-IND.
     MOVE 0 TO CRITERIA-IND.
     MOVE 0 TO CRUPDATEDPAGESPCT-IND.
     MOVE 0 TO CRCHANGESPCT-IND.
     MOVE 0 TO RRTINSDELUPDPCT-IND.
     MOVE 0 TO RRTUNCLUSTINSPCT-IND.
     MOVE 0 TO RRTDISORGLOBPCT-IND.
     MOVE 0 TO RRIAPPENDINSERTPCT-IND.
     MOVE 0 TO SRTINSDELUPDPCT-IND.
     MOVE 0 TO SRIINSDELUPDPCT-IND.
     MOVE 0 TO EXTENTLIMIT-IND.
     MOVE 0 TO LASTSTATEMENT-IND.
     MOVE 0 TO RETURNCODE-IND.
     MOVE 0 TO ERRORMSG-IND.
     MOVE 0 TO IFCARETCODE-IND.
     MOVE 0 TO IFCARESCODE-IND.
     MOVE 0 TO EXCESSBYTES-IND.
.
.
.
*****************
* CALL DSNACCOR *
*****************
     EXEC SQL
      CALL SYSPROC.DSNACCOR
      (:QUERYTYPE           :QUERYTYPE-IND,
```

```
       :OBJECTTYPE          :OBJECTTYPE-IND,
       :ICTYPE              :ICTYPE-IND,
       :STATSSCHEMA         :STATSSCHEMA-IND,
       :CATLGSCHEMA         :CATLGSCHEMA-IND,
       :LOCALSCHEMA         :LOCALSCHEMA-IND,
       :CHKLVL              :CHKLVL-IND,
       :CRITERIA            :CRITERIA-IND,
       :RESTRICTED          :RESTRICTED-IND,
       :CRUPDATEDPAGESPCT   :CRUPDATEDPAGESPCT-IND,
       :CRCHANGESPCT        :CRCHANGESPCT-IND,
       :CRDAYSNCLASTCOPY    :CRDAYSNCLASTCOPY-IND,
       :ICRUPDATEDPAGESPCT  :ICRUPDATEDPAGESPCT-IND,
       :ICRCHANGESPCT       :ICRCHANGESPCT-IND,
       :CRINDEXSIZE         :CRINDEXSIZE-IND,
       :RRTINSDELUPDPCT     :RRTINSDELUPDPCT-IND,
       :RRTUNCLUSTINSPCT    :RRTUNCLUSTINSPCT-IND,
       :RRTDISORGLOBPCT     :RRTDISORGLOBPCT-IND,
       :RRTMASSDELLIMIT     :RRTMASSDELLIMIT-IND,
       :RRTINDREFLIMIT      :RRTINDREFLIMIT-IND,
       :RRIINSERTDELETEPCT  :RRIINSERTDELETEPCT-IND,
       :RRIAPPENDINSERTPCT  :RRIAPPENDINSERTPCT-IND,
       :RRIPSEUDODELETEPCT  :RRIPSEUDODELETEPCT-IND,
       :RRIMASSDELLIMIT     :RRIMASSDELLIMIT-IND,
       :RRILEAFLIMIT        :RRILEAFLIMIT-IND,
       :RRINUMLEVELSLIMIT   :RRINUMLEVELSLIMIT-IND,
       :SRTINSDELUPDPCT     :SRTINSDELUPDPCT-IND,
       :SRTINSDELUPDABS     :SRTINSDELUPDABS-IND,
       :SRTMASSDELLIMIT     :SRTMASSDELLIMIT-IND,
       :SRIINSDELUPDPCT     :SRIINSDELUPDPCT-IND,
       :SRIINSDELUPDABS     :SRIINSDELUPDABS-IND,
       :SRIMASSDELLIMIT     :SRIMASSDELLIMIT-IND,
       :EXTENTLIMIT         :EXTENTLIMIT-IND,
       :LASTSTATEMENT       :LASTSTATEMENT-IND,
       :RETURNCODE          :RETURNCODE-IND,
       :ERRORMSG            :ERRORMSG-IND,
       :IFCARETCODE         :IFCARETCODE-IND,
       :IFCARESCODE         :IFCARESCODE-IND,
       :EXCESSBYTES         :EXCESSBYTES-IND)
     END-EXEC.
************************************************************
* ASSUME THAT THE SQL CALL RETURNED +466, WHICH MEANS THAT  *
* RESULT SETS WERE RETURNED. RETRIEVE RESULT SETS.          *
************************************************************
* LINK EACH RESULT SET TO A LOCATOR VARIABLE
     EXEC SQL ASSOCIATE LOCATORS (:LOC1, :LOC2)
       WITH PROCEDURE SYSPROC.DSNACCOR
     END-EXEC.
* LINK A CURSOR TO EACH RESULT SET
     EXEC SQL ALLOCATE C1 CURSOR FOR RESULT SET :LOC1
     END-EXEC.
     EXEC SQL ALLOCATE C2 CURSOR FOR RESULT SET :LOC2
     END-EXEC.
* PERFORM FETCHES USING C1 TO RETRIEVE ALL ROWS FROM FIRST RESULT SET
* PERFORM FETCHES USING C2 TO RETRIEVE ALL ROWS FROM SECOND RESULT SET
```

Figure 149. Example of DSNACCOR invocation

Output

If DSNACCOR executes successfully, in addition to the output parameters described in "Option descriptions" on page 1050, DSNACCOR returns two result sets.

The first result set contains the results from IFI COMMAND calls that DSNACCOR makes. The following table shows the format of the first result set.

Table 147. Result set row for first DSNACCOR result set

Column name	Data type	Contents
RS_SEQUENCE	INTEGER	Sequence number of the output line
RS_DATA	CHAR(80)	A line of command output

The result set contains rows for table spaces, index spaces, or partitions, if both of the following conditions are true for the object:

- If the *Criteria* input parameter contains a search condition, and the search condition is true for the table space, index space, or partition.
- DSNACCOR recommends at least one action for the table space, index space, or partition.

The result set contains one row for each nonpartitioned table space or nonpartitioning index space. For partitioned table spaces or partitioning indexes, the result set contains one row for each partition. If *ChkLvl* 8 is specified, the result set might contain additional rows, including duplicate rows for the same object.

The following table shows the columns of a result set row.

Table 148. Result set row for second DSNACCOR result set

Column name	Data type	Description
DBNAME	CHAR(8)	Name of the database that contains the object.
NAME	CHAR(8)	Table space or index space name.
PARTITION	INTEGER	Data set number or partition number.
OBJECTTYPE	CHAR(2)	DB2 object type: • TS for a table space • IX for an index space
OBJECTSTATUS	CHAR(36)	Status of the object: • ORPHANED, if the object is an index space with no corresponding table space, or if the object does not exist • If the object is in a restricted state, one of the following values: – TS=*restricted-state*, if OBJECTTYPE is TS – IX=*restricted-state*, if OBJECTTYPE is IX *restricted-state* is one of the status codes that appear in DISPLAY DATABASE output. **Related information:** DSNT362I (DB2 Messages) -DISPLAY DATABASE (DB2) (DB2 Commands) • A, if the object is in an advisory state. • L, if the object is a logical partition, but not in an advisory state. • AL, if the object is a logical partition and in an advisory state.

Table 148. Result set row for second DSNACCOR result set (continued)

Column name	Data type	Description
IMAGECOPY	CHAR(3)	COPY recommendation: • If OBJECTTYPE is TS: FUL (full image copy), INC (incremental image copy), or NO • If OBJECTTYPE is IX: YES or NO
RUNSTATS	CHAR(3)	RUNSTATS recommendation: YES or NO.
EXTENTS	CHAR(3)	Indicates whether the data sets for the object have exceeded *ExtentLimit*: YES or NO.
REORG	CHAR(3)	REORG recommendation: YES or NO.
INEXCEPTTABLE	CHAR(40)	A string that contains one of the following values: • Text that you specify in the QUERYTYPE column of the exception table. • YES, if you put a row in the exception table for the object that this result set row represents, but you specify NULL in the QUERYTYPE column. • NO, if the exception table exists but does not have a row for the object that this result set row represents. • Null, if the exception table does not exist, or if the *ChkLvl* input parameter does not include the value 4.
ASSOCIATEDTS	CHAR(8)	If OBJECTTYPE is IX and the *ChkLvl* input parameter includes the value 2, this value is the name of the table space that is associated with the index space. Otherwise null.
COPYLASTTIME	TIMESTAMP	Timestamp of the last full or incremental image copy on the object. Null if COPY was never run, or if the last COPY execution was terminated.
LOADRLASTTIME	TIMESTAMP	Timestamp of the last LOAD REPLACE on the object. Null if LOAD REPLACE was never run, or if the last LOAD REPLACE execution was terminated.
REBUILDLASTTIME	TIMESTAMP	Timestamp of the last REBUILD INDEX on the object. Null if REBUILD INDEX was never run, or if the last REBUILD INDEX execution was terminated.
CRUPDPGSPCT	INTEGER	If OBJECTTYPE is TS or IX and IMAGECOPY is YES, the ratio of distinct updated pages to preformatted pages, expressed as a percentage. Otherwise null.
CRCPYCHGPCT	INTEGER	If OBJECTTYPE is TS and IMAGECOPY is YES, the ratio of the total number insert, update, and delete operations since the last image copy to the total number of rows or LOBs in the table space or partition, expressed as a percentage. If OBJECTTYPE is IX and IMAGECOPY is YES, the ratio of the total number of insert and delete operations since the last image copy to the total number of entries in the index space or partition, expressed as a percentage. Otherwise null.
CRDAYSCELSTCPY	INTEGER	If OBJECTTYPE is TS or IX and IMAGECOPY is YES, the number of days since the last image copy. Otherwise null.
CRINDEXSIZE	INTEGER	If OBJECTTYPE is IX and IMAGECOPY is YES, the number of active pages in the index space or partition. Otherwise null.
REORGLASTTIME	TIMESTAMP	Timestamp of the last REORG on the object. Null if REORG was never run, or if the last REORG execution was terminated.

Table 148. Result set row for second DSNACCOR result set (continued)

Column name	Data type	Description
RRTINSDELUPDPCT	INTEGER	If OBJECTTYPE is TS and REORG is YES, the ratio of the sum of insert, update, and delete operations since the last REORG to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null.
RRTUNCINSPCT	INTEGER	If OBJECTTYPE is TS and REORG is YES, the ratio of the number of unclustered insert operations to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null.
RRTDISORGLOBPCT	INTEGER	If OBJECTTYPE is TS and REORG is YES, the ratio of the number of imperfectly chunked LOBs to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null.
RRTMASSDELETE	INTEGER	If OBJECTTYPE is TS, REORG is YES, and the table space is a segmented table space or LOB table space, the number of mass deletes since the last REORG or LOAD REPLACE. If OBJECTTYPE is TS, REORG is YES, and the table space is nonsegmented, the number of dropped tables since the last REORG or LOAD REPLACE. Otherwise null.
RRTINDREF	INTEGER	If OBJECTTYPE is TS, REORG is YES, the ratio of the total number of overflow records that were created since the last REORG or LOAD REPLACE to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null.
RRIINSDELPCT	INTEGER	If OBJECTTYPE is IX and REORG is YES, the ratio of the total number of insert and delete operations since the last REORG to the total number of index entries in the index space or partition, expressed as a percentage. Otherwise null.
RRIAPPINSPCT	INTEGER	If OBJECTTYPE is IX and REORG is YES, the ratio of the number of index entries that were inserted since the last REORG, REBUILD INDEX, or LOAD REPLACE that had a key value greater than the maximum key value in the index space or partition, to the number of index entries in the index space or partition, expressed as a percentage. Otherwise null.
RRIPSDDELPCT	INTEGER	If OBJECTTYPE is IX and REORG is YES, the ratio of the number of index entries that were pseudo-deleted (the RID entry was marked as deleted) since the last REORG, REBUILD INDEX, or LOAD REPLACE to the number of index entries in the index space or partition, expressed as a percentage. Otherwise null.
RRIMASSDELETE	INTEGER	If OBJECTTYPE is IX and REORG is YES, the number of mass deletes from the index space or partition since the last REORG, REBUILD, or LOAD REPLACE. Otherwise null.
RRILEAF	INTEGER	If OBJECTTYPE is IX and REORG is YES, the ratio of the number of index page splits that occurred since the last REORG, REBUILD INDEX, or LOAD REPLACE in which the higher part of the split page was far from the location of the original page, to the total number of active pages in the index space or partition, expressed as a percentage. Otherwise null.
RRINUMLEVELS	INTEGER	If OBJECTTYPE is IX and REORG is YES, the number of levels in the index tree that were added or removed since the last REORG, REBUILD INDEX, or LOAD REPLACE. Otherwise null.

Table 148. Result set row for second DSNACCOR result set (continued)

Column name	Data type	Description
STATSLASTTIME	TIMESTAMP	Timestamp of the last RUNSTATS on the object. Null if RUNSTATS was never run, or if the last RUNSTATS execution was terminated.
SRTINSDELUPDPCT	INTEGER	If OBJECTTYPE is TS and RUNSTATS is YES, the ratio of the total number of insert, update, and delete operations since the last RUNSTATS on a table space or partition, to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null.
SRTINSDELUPDABS	INTEGER	If OBJECTTYPE is TS and RUNSTATS is YES, the total number of insert, update, and delete operations since the last RUNSTATS on a table space or partition. Otherwise null.
SRTMASSDELETE	INTEGER	If OBJECTTYPE is TS and RUNSTATS is YES, the number of mass deletes from the table space or partition since the last REORG or LOAD REPLACE. Otherwise null.
SRIINSDELPCT	INTEGER	If OBJECTTYPE is IX and RUNSTATS is YES, the ratio of the total number of insert and delete operations since the last RUNSTATS on the index space or partition, to the total number of index entries in the index space or partition, expressed as a percentage. Otherwise null.
SRIINSDELABS	INTEGER	If OBJECTTYPE is IX and RUNSTATS is YES, the number insert and delete operations since the last RUNSTATS on the index space or partition. Otherwise null.
SRIMASSDELETE	INTEGER	If OBJECTTYPE is IX and RUNSTATS is YES, the number of mass deletes from the index space or partition since the last REORG, REBUILD INDEX, or LOAD REPLACE. Otherwise, this value is null.
TOTALEXTENTS	SMALLINT	If EXTENTS is YES, the number of physical extents in the table space, index space, or partition. Otherwise, this value is null.

PSPI

Related reference:

CREATE DATABASE (DB2 SQL)

CREATE TABLESPACE (DB2 SQL)

DSNACCOX stored procedure

The DB2 real-time statistics stored procedure (DSNACCOX) is a sample stored procedure that makes recommendations to help you maintain your DB2 databases.

PSPI

The DSNACCOX stored procedure represents an enhancement to the DSNACCOR stored procedure and provides the following improvements:

- Improved recommendations
- New fields
- New formulas
- The option to choose the formula for making recommendations

You can call the DSNACCOX stored procedure to accomplish the following actions:

- Get recommendations for when to reorganize, image copy, or update statistics for table spaces or index spaces
- Identify when a data set has exceeded a specified threshold for the number of extents that it occupies.
- Identify whether objects are in restricted states

DSNACCOX uses data from catalog tables, including real-time statistics tables, to make its recommendations. DSNACCOX provides its recommendations in a result set.

DSNACCOX uses the set of criteria that are shown in "DSNACCOX formulas for recommending actions" on page 1084 to evaluate table spaces and index spaces. By default, DSNACCOX evaluates all table spaces and index spaces in the subsystem that have entries in the real-time statistics tables. However, you can override this default through input parameters.

About DSNACCOX recommendations

- You can improve the quality of DSNACCOX recommendations, especially for frequently changed objects, by externalizing in-memory statistics to the real-time statistics tables immediately before calling the stored procedure.

  Related information:

  Updating real-time statistics immediately (DB2 Performance)

  When DB2 externalizes real-time statistics (DB2 Performance)

  -ACCESS DATABASE (DB2) (DB2 Commands)
- DSNACCOX makes recommendations based on general formulas that require input from the user about the maintenance policies for a subsystem. These recommendations might not be accurate for every installation.
- If the real-time statistics tables contain information for only a small percentage of your DB2 subsystem, the recommendations that DSNACCOX makes might not be accurate for the entire subsystem.
- Before you perform any action that DSNACCOX recommends, ensure that the object for which DSNACCOX makes the recommendation is available, and that the recommended action can be performed on that object. For example, REORG might be recommended for an object, but the object might be stopped.

Environment

DSNACCOX must run in a WLM-established stored procedure address space.The DSNWLM_GENERAL core WLM environment is a suitable environment for this stored procedure.

DSNACCOX is installed and configured by installation job DSNTIJRT, which binds the package for DSNACCOX with isolation UR to avoid lock contention.

Authorization required

To execute the CALL DSNACCOX statement, the owner of the package or plan that contains the CALL statement must have one or more of the following privileges on each package that the stored procedure uses:

- The EXECUTE privilege on the package for DSNACCOX
- Ownership of the package
- PACKADM authority for the package collection

- SYSADM authority

The owner of the package or plan that contains the CALL statement must also have:

- SELECT authority on catalog tables
- The DISPLAY system privilege

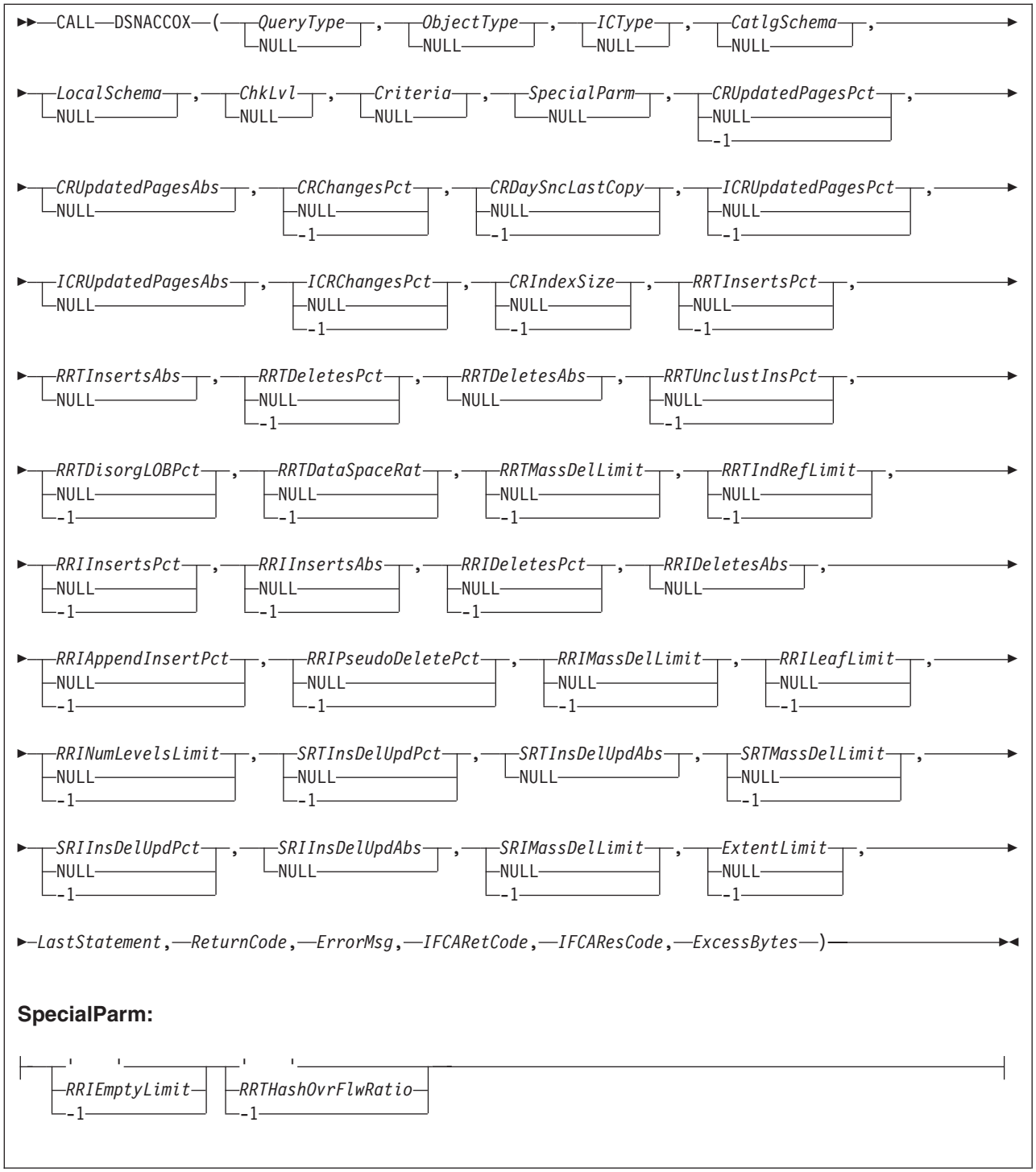
Syntax diagram

The following syntax diagram shows the CALL statement for invoking DSNACCOX. Because the linkage convention for DSNACCOX is GENERAL WITH NULLS, if you pass parameters in host variables, you need to include a null indicator with every host variable. Null indicators for input host variables must be initialized before you execute the CALL statement.

Related information:

Indicator variables, arrays, and structures (DB2 Application programming and SQL)

Linkage conventions for external stored procedures (DB2 Application programming and SQL)



Option descriptions

In the following option descriptions, the default value for an input parameter is the value that DSNACCOX uses if you specify a null value.

QueryType
Specifies the types of actions that DSNACCOX recommends. This field contains one or more of the following values. Each value is enclosed in single quotation marks and separated from other values by a space.

ALL Makes recommendations for all of the following actions.

COPY Makes a recommendation on whether run an image copy.

RUNSTATS
Makes a recommendation on whether to run RUNSTATS.

REORG
Makes a recommendation on whether to run REORG. Choosing this value causes DSNACCOX to process the EXTENTS value also.

EXTENTS
Indicates when data sets have exceeded a user-specified extents limit.

RESTRICT
Indicates which objects are in a restricted state.

DSNACCOX recommends REORG on the table space when one of the following conditions is true, and REORG (or ALL) is also specified for the value of QUERYTYPE:

- The table space is in REORG-pending status.
- The table space is in advisory REORG-pending status as the result of an ALTER TABLE statement.

DSNACCOX recommends REORG on the index when on the following conditions is true and REORG (or ALL) is also specified for the value of QUERYTYPE::

- The index is in REORG-pending status.
- The index is in advisory REORG-pending as the result of an ALTER TABLE statement.

DSNACCOX recommends FULL COPY on the table space when on the following conditions is true and COPY (or ALL) is also specified for the value of QUERYTYPE::

- The table space is in COPY-pending status.
- The table space is in informational COPY-pending status.

DSNACCOX recommends FULL COPY on the index when on the following conditions is true and COPY (or ALL) is also specified for the value of QUERYTYPE: and SYSINDEX.COPY='Y':

- The index is in COPY-pending status.
- The index is in informational COPY-pending status.

QueryType is an input parameter of type VARCHAR(40). The default value is **ALL**.

ObjectType
Specifies the types of objects for which DSNACCOX recommends actions:

ALL Table spaces and index spaces.

TS Table spaces only.

IX Index spaces only.

ObjectType is an input parameter of type VARCHAR(3). The default value is **ALL**.

ICType
Specifies the types of image copies for which DSNACCOX is to make recommendations:

F Full image copy.

I Incremental image copy. This value is valid for table spaces only.

B Full image copy or incremental image copy.

ICType is an input parameter of type VARCHAR(1). The default is **B**.

CatlgSchema
Specifies the qualifier for DB2 catalog table names. *CatlgSchema* is an input parameter of type VARCHAR(128). The default value is **SYSIBM**.

LocalSchema
Specifies the qualifier for the names of local tables that DSNACCOX references. *LocalSchema* is an input parameter of type VARCHAR(128). The default value is **DSNACC**.

ChkLvl
Specifies the types of checking that DSNACCOX performs, and indicates whether to include objects that fail those checks in the DSNACCOX recommendations result set. This value is the sum of any combination of the following values:

0 DSNACCOX performs none of the following actions.

1 Exclude rows from the DSNACCOX recommendations result set for RUNSTATS on:

- Index spaces that are related to tables that are defined as VOLATILE.
- Table spaces for which all of the tables are defined as VOLATILE.

2 Choosing this value causes DSNACCOX to over-ride the default SSDMultiplier when making a REORG recommendation for a table space or table space partition. The default value is 2 times RRTUnclustInsPct. If CHKLVL 2 is specified RRTUnclustInsPct * 5 is used.

4 Check whether rows that are in the DSNACCOX recommendations result set refer to objects that are in the exception table. For recommendations result set rows that have corresponding exception table rows, copy the contents of the QUERYTYPE column of the exception table to the INEXCEPTTABLE column of the recommendations result set.

8 Check for objects that have restricted states. The value of the *QueryType* option must be ALL or contain RESTRICTED when this value is specified. The OBJECTSTATUS column of the result set indicates the restricted state of the object. A row is added to the result set for each object that has a restricted state.

16 Reserved for future use.

32 Exclude rows from the DSNACCOX recommendations result set for index spaces for which the related table spaces have been recommended for REORG or RUNSTATS.

64 For index spaces that are listed in the DSNACCOX recommendations result set, check whether the related table spaces are listed in the exception table. For recommendations result set rows that have corresponding exception table rows, copy the contents of the QUERYTYPE column of the exception table to the INEXCEPTTABLE column of the recommendations result set. Selecting CHKLVL64 also activates CHKLVLs 32 and 4.

ChkLvl is an input parameter of type INTEGER. The default is **5** (values 1+4).

Criteria
Narrows the set of objects for which DSNACCOX makes recommendations. This value is the search condition of an SQL WHERE clause.*Criteria* is an input parameter of type VARCHAR(4096). The default is that DSNACCOX makes recommendations for all table spaces and index spaces in the subsystem. The search condition can use any column in the result set and wildcards are allowed.

DSNACCOX can optimize the retrieval of recommendations if the *criteria* references only the following columns in the real-time statistics tables:

- DBNAME
- NAME
- PARTITION
- DBID
- PSID

SpecialParm
SpecialParm is an input of type CHAR(160), broken into 4 byte sections to accommodate new options. An empty 4 bytes of EBCDIC blanks indicates that the default is used for the option. An EBCDIC character string of '-1', indicates that this option is not used.

RRIEmptyLimit
Is the ratio of pseudo-empty pages to the total number of leaf pages. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than RRIEmptyLimit, DSNACCOX recommends running REORG: The number of pseudo-empty leaf pages that were created since the last CREATE, REORG, REBUILD INDEX, or LOAD REPLACE, divided by the total number of leaf pages in the index space or partition, expressed as a percentage.

RRIEmptyLimit is an input parameter of type CHAR 4. The default value is ' 10'. A plus sign (+) preceding the value indicates that the DSNACCOX stored procedure returns the value in the result set. A negative value turns off this criterion.

The ratio of pseudo-empty pages to the total number of leaf pages is returned in column RRIEMPTYLIMIT of the result set.

RRTHashOvrFlwRatio
The ratio of hash access overflow index entries to the total number of rows. Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOX recommends running REORG: The hash access overflow index is being used for access, and the ratio of hash access overflow index entries divided by the total number of rows (expressed as a percentage) is greater than RRTHashOvrFlwRatio.

RRTHashOvrFlwRatio is an input parameter of type CHAR 4. The default value is ' 15'. A plus sign (+) preceding or after the value or by itself indicates that the DSNACCOX stored procedure returns the calculated ratio value in the result set. The value of the *ObjectType* parameter must be ALL, or contain both TS and IX, for this criterion to be used. A negative value turns off this criterion.

The ratio of Hash Access overflow index entries to the total number of rows is returned in the RRTHASHOVRFLWRAT column of the result set.

CRUpdatedPagesPct

Is the ratio of the total number of distinct updated pages to the total number of preformatted pages. Specifies, when combined with *CRUpdatedPagesAbs*, a criterion for recommending a full image copy on a table space or index space. If both of the following conditions are true for a table space, DSNACCOX recommends an image copy:

- The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct*.
- The total number of distinct updates pages is greater than *CRUpdatedPagesABS*.

If all of the following conditions are true for an index space, DSNACCOX recommends an image copy:

- The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct.*
- The total number of distinct updates pages is greater than *CRUpdatedPagesABS*.
- The number of active pages in the index space or partition is greater than *CRIndexSize*.

CRUpdatedPagesPct is an input parameter of type DOUBLE. The default is **20.0**. A negative value turns off both this criteria and *CRUpdatedPagesABS*.

CRUpdatedPagesABS

Is the total number of distinct updated pages. Specifies, when combined with *CRUpdatedPagesPct*, a criterion for recommending a full image copy on a table space or index space. If both of the following conditions are true for a table space, DSNACCOX recommends an image copy:

- The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct*.
- The total number of distinct updated pages is greater than *CRUpdatedPagesAbs*.

If all of the following conditions are true for an index space, DSNACCOX recommends an image copy:

- The total number of distinct updated pages, divided by the total number of preformatted pages (expressed as a percentage) is greater than *CRUpdatedPagesPct.*
- The total number of distinct updates pages is greater than *CRUpdatedPagesAbs*.
- The number of active pages in the index space or partition is greater than *CRIndexSize*.

CRUpdatedPagesAbs is an input parameter of type INTEGER. The default value is **0**.

CRChangesPct

Is the ratio of the total number of insert, update, and delete operations to the total number of rows. Specifies a criterion for recommending a full image copy on a table space or index space. If the following condition is true for a table space, DSNACCOX recommends an image copy:

The total number of insert, update, and delete operations since the last image copy, divided by the total number of rows or LOBs in a table space or partition (expressed as a percentage) is greater than *CRChangesPct.*

If both of the following conditions are true for an index table space, DSNACCOX recommends an image copy:

- The total number of insert and delete operations since the last image copy, divided by the total number of entries in the index space or partition (expressed as a percentage) is greater than *CRChangesPct*.
- The number of active pages in the index space or partition is greater than *CRIndexSize.*

CRChangesPct is an input parameter of type DOUBLE. The default is **10.0**. A negative value turns off this criterion.

CRDaySncLastCopy
Is the number of days since the last image copy. Specifies a criterion for recommending a full image copy on a table space or index space. If the number of days since the last image copy is greater than this value, DSNACCOX recommends an image copy.

CRDaySncLastCopy is an input parameter of type INTEGER. The default is **7**. A negative value turns off this criterion.

ICRUpdatedPagesPct
Is the ratio of the total number of distinct updated pages to the total number of preformatted pages. Specifies a criterion for recommending an incremental image copy on a table space. If both of the following conditions are true, DSNACCOX recommends an incremental image copy:

- The number of distinct pages that were updated since the last image copy, divided by the total number of active pages in the table space or partition (expressed as a percentage) is greater than *ICRUpdatedPagesPct*..
- The number of distinct pages that were updated since last image copy is greater than *ICRUpdatedPagesAbs*.

ICRUpdatedPagesPct is an input parameter of type DOUBLE. The default value is **1.0**. A negative value turns off this criterion and *ICRUpdatedPagesAbs*.

ICRUpdatedPagesAbs
Is the total number of distinct updated pages. Specifies, when combined with *ICRUpdatedPagesPct*, a criterion for recommending an incremental image copy on a table space. If both of the following conditions are true, DSNACCOX recommends an incremental image copy:

- The number of distinct pages that were updated since the last image copy, divided by the total number of active pages in the table space or partition (expressed as a percentage) is greater than *ICRUpdatedPagesPct*.
- The number of distinct pages that were updated since last image copy is greater than *ICRUpdatedPagesAbs*.

ICRUpdatedPagesAbs is an input parameter of type INTEGER. The default is 0.

ICRChangesPct
Is the ratio of the total number of insert, update, or delete operations to the total number of rows. Specifies a criterion for recommending an incremental image copy on a table space. If the following condition is true, DSNACCOX recommends an incremental image copy:

The ratio of the number of insert, update, or delete operations since the last image copy, to the total number of rows or LOBs in a table space or partition (expressed as a percentage) is greater than *ICRChangesPct.*

ICRChangesPct is an input parameter of type DOUBLE. The default is **1.0**. A negative value turns off this criterion.

CRIndexSize

Is the minimum index size. Specifies the minimum index size before checking the *CRUpdatedPagesPct* or *CRChangesPct* criteria for recommending a full image copy on an index space.

CRIndexSize is an input parameter of type INTEGER. The default is **50**. A negative value turns of this criterion and *ICRChangesPct*.

RRTInsertsPct

Is the ratio of total number of insert operations to the total number of rows. Specifies, when combined with *RRTInsertsAbs*, a criterion for recommending that the REORG utility is to be run on a table space. If both of the following condition are true, DSNACCOX recommends running REORG:

- The sum of insert, update, and delete operations since the last REORG, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTInsertsPct*
- The sum of insert operations since the last REORG is greater than *RRTInsertsAbs*.

RRTInsertsPct is an input parameter of type DOUBLE. The default value is **25.0**. A negative value turns off this criterion and *RRTInsertsAbs*.

RRTInsertsAbs

Is the total number of insert operations. Specifies, when combined with *RRTInsertsPct*, a criterion for recommending that the REORG utility is to be run on a table space. If both of the following condition are true, DSNACCOX recommends running REORG:

- The sum of insert operations since the last REORG, divided by the total number of rows or in the table space or partition (expressed as a percentage) is greater than *RRTInsertsPct*
- The sum of insert operations since the last REORG is greater than *RRTInsertsAbs*.

RRTInsertsAbs is an input parameter of type INTEGER. The default value is **0**.

RRTDeletesPct

Is the ratio of the total number of delete operations to the total number of rows. Specifies, when combined with *RRTDeletesAbs*, a criterion for recommending that the REORG utility is to be run on a table space. If both of the following condition are true, DSNACCOX recommends running REORG:

- The sum of delete operations since the last REORG, divided by the total number of rows or in the table space or partition (expressed as a percentage) is greater than *RRTDeletesPct*
- The sum of delete operations since the last REORG is greater than *RRTDeletesAbs*.

RRTDeletesPct is an input parameter of type DOUBLE. The default value is **25.0**. A negative value turns off this criterion and *RRTDeletesAbs*.

RRTDeletesAbs

Is the total number of delete operations. Specifies, when combined with *RRTDeletesPct*, a criterion for recommending that the REORG utility is to be run on a table space. If both of the following condition are true, DSNACCOX recommends running REORG:

- The sum of delete operations since the last REORG, divided by the total number of rows or in the table space or partition (expressed as a percentage) is greater than *RRTDeletesPct*
- The sum of delete operations since the last REORG is greater than *RRTDeletesAbs*.

RRTDeletesAbs is an input parameter of type INTEGER. The default value is **0**.

RRTUnclustInsPct
Is the ratio of the total number of unclustered insert operations to the total number of rows. Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOX recommends running REORG:

The number of unclustered insert operations, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTUnclustInsPct*.

RRTUnclustInsPct is an input parameter of type DOUBLE. The default is **10.0**. A negative value will turn off this criterion.

RRTDisorgLOBPct
Is the ratio of the number of imperfectly chunked LOBs to the total number of rows. Specifies a criterion for recommending that the REORG utility is to be run on a table space. If the following condition is true, DSNACCOX recommends running REORG:

The number of imperfectly chunked LOBs, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage) is greater than *RRTDisorgLOBPct.*

RRTDisorgLOBPct is an input parameter of type DOUBLE. The default is **50.0**. A negative value will turn off this criterion.

RRTDataSpaceRat
Is the ratio of the space allocated to the actual space used. Specifies a criterion for recommending that the REORG utility is to be run on table space for space reclamation. If the following condition is true, DSNACCOX recommends running REORG:

The object is not using hash organization.

The SPACE allocated is greater than RRTDataSpaceRat multiplied by the actual space used. (SPACE > RRTDataSpaceRat × (DATASIZE/1024))

RRTDataSpaceRat is an input parameter of type DOUBLE. The default value is **-1**. A negative value turns off this criterion.

RRTMassDelLimit
Is the sum of the number of mass deletes. Specifies a criterion for recommending that the REORG utility is to be run on a table space. If one of the following values is greater than *RRTMassDelLimit*, DSNACCOX recommends running REORG:

- The sum of mass deletes from a segmented or LOB table space since the last REORG or LOAD REPLACE
- The number of dropped tables from a nonsegmented table space since the last REORG or LOAD REPLACE

RRTMassDelLimit is an input parameter of type INTEGER. The default is **0**.

RRTIndRefLimit
Is the ratio of the total number of overflow records that were created to the total number of rows. Specifies a criterion for recommending that the REORG

utility is to be run on a table space. If the following value is greater than *RRTIndRefLimit*, DSNACCOX recommends running REORG:

The total number of overflow records that were created since the last REORG or LOAD REPLACE, divided by the total number of rows or LOBs in the table space or partition (expressed as a percentage)

RRTIndRefLimit is an input parameter of type DOUBLE. The default is **5.0** in data sharing environment and **10.0** in a non-data sharing environment.

RRIInsertsPct

Is the ratio of the total number of index entries that were inserted to the total number of index entries. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the both of the following conditions are true, DSNACCOX recommends running REORG:

- The sum of the number of index entries that were inserted since the last REORG, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *RRIInsertsPct*.
- The sum of the number of index entries that were inserted since the last REORG is greater than *RRIInsertsAbs*.

RRIInsertsPct is an input parameter of type DOUBLE. The default is **30.0**. A negative value turns off this criterion.

RRIInsertsAbs

Is the sum of the number of index entries that were inserted. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If both of the following conditions are true, DSNACCOX recommends running REORG:

- The sum of the number of index entries that were inserted since the last REORG, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *RRIInsertsPct*.
- The sum of the number of index entries that were inserted since the last REORG is greater than *RRIInsertsAbs*.

RRIInsertsAbs is an input parameter of type INTEGER. The default is **0**. A negative value turns off this criterion.

RRIDeletesPct

Is the ratio of the sum of the number of index entries that were deleted to the total number of index entries. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIDeletesPct*, DSNACCOX recommends running REORG:

- The sum of the number of index entries that were deleted since the last REORG, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *RRIDeletesPct*.
- The sum of the number of index entries that were deleted since the last REORG is greater than *RRIDeletesAbs*.

RRIDeletesPct is an input parameter of type DOUBLE. The default is **30.0**. A negative value turns off this criterion.

RRIDeletesAbs

Is the sum of the number of index entries that were deleted. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIDeletesPct*, DSNACCOX recommends running REORG:

- The sum of the number of index entries that were deleted since the last REORG, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *RRIDeletesPct*.
- The sum of the number of index entries that were deleted since the last REORG is greater than *RRIDeletesAbs*.

RRIDeletesAbs is an input parameter of type INTEGER. The default is **0**. A negative value turns off this criterion.

RRIAppendInsertPct
Is the ratio of the number of index entries that were inserted with a key value greater than the maximum key value in the index space or partition to the number of index entries. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIAppendInsertPct*, DSNACCOX recommends running REORG:

The number of index entries that were inserted since the last REORG, REBUILD INDEX, or LOAD REPLACE with a key value greater than the maximum key value in the index space or partition, divided by the number of index entries in the index space or partition (expressed as a percentage)

RRIInsertDeletePct is an input parameter of type DOUBLE. The default is **20.0**. A negative value turns off this criterion.

RRIPseudoDeletePct
Is the ratio of the number of index entries that were pseudo-deleted to the number of index entries. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRIPseudoDeletePct*, DSNACCOX recommends running REORG:

The number of index entries that were pseudo-deleted since the last REORG, REBUILD INDEX, or LOAD REPLACE, divided by the number of index entries in the index space or partition (expressed as a percentage)

RRIPseudoDeletePct is an input parameter of type DOUBLE. The default is **5.0** in data sharing and **10.0** in non-data sharing environments. A negative value turns off this criterion.

RRIMassDelLimit
Is the sum of the number of mass deletes of index entries. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the number of mass deletes from an index space or partition since the last REORG, REBUILD, or LOAD REPLACE is greater than this value, DSNACCOX recommends running REORG.

RRIMassDelLimit is an input parameter of type INTEGER. The default is **0**. A negative value turns off this criterion.

RRILeafLimit
Is the ratio of the number of index page splits in which the higher part of the split page was far from the location of the original page to the total number of active pages. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRILeafLimit*, DSNACCOX recommends running REORG:

The number of index page splits that occurred since the last REORG, REBUILD INDEX, or LOAD REPLACE in which the higher part of the split page was far from the location of the original page, divided by the total number of active pages in the index space or partition (expressed as a percentage)

RRILeafLimit is an input parameter of type DOUBLE. The default is **10.0**. A negative value turns off this criterion.

RRINumLevelsLimit

Is the number of levels in the index tree that were added or removed. Specifies a criterion for recommending that the REORG utility is to be run on an index space. If the following value is greater than *RRINumLevelsLimit*, DSNACCOX recommends running REORG:

The number of levels in the index tree that were added or removed since the last REORG, REBUILD INDEX, or LOAD REPLACE

RRINumLevelsLimit is an input parameter of type INTEGER. The default is **0**. A negative value turns off this criterion.

SRTInsDelUpdPct

Is the ratio of the total number of insert, update, or delete operations to the total number of rows. Specifies, when combined with *SRTInsDelUpdAbs*, a criterion for recommending that the RUNSTATS utility is to be run on a table space. If both of the following conditions are true, DSNACCOX recommends running RUNSTATS:

- The number of insert, update, or delete operations since the last RUNSTATS on a table space or partition, divided by the total number of rows or LOBs in table space or partition (expressed as a percentage) is greater than *SRTInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRTInsDelUpdAbs.*

SRTInsDelUpdPct is an input parameter of type DOUBLE. The default is **20.0**. A negative value turns off this criterion.

SRTInsDelUpdAbs

Is the number of insert, update, and delete operations. Specifies, when combined with *SRTInsDelUpdPct*, a criterion for recommending that the RUNSTATS utility is to be run on a table space. If both of the following conditions are true, DSNACCOX recommends running RUNSTATS:

- The number of insert, update, and delete operations since the last RUNSTATS on a table space or partition, divided by the total number of rows or LOBs in table space or partition (expressed as a percentage) is greater than *SRTInsDelUpdPct.*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRTInsDelUpdAbs.*

SRTInsDelUpdAbs is an input parameter of type INTEGER. The default is **0**.

SRTMassDelLimit

Is the sum of the number of mass deletes. Specifies a criterion for recommending that the RUNSTATS utility is to be run on a table space. If the following condition is true, DSNACCOX recommends running RUNSTATS:

- The number of mass deletes from a table space or partition since the last REORG or LOAD REPLACE is greater than *SRTMassDelLimit.*

SRTMassDelLimit is an input parameter of type INTEGER. The default is **0.0**. A negative value turns off this criterion.

SRIInsDelPct

Is the ratio of the total number of inserted and deleted index entries to the total number of index entries. Specifies, when combined with *SRIInsDelAbs*, a

criterion for recommending that the RUNSTATS utility is to be run on an index space. If both of the following conditions are true, DSNACCOX recommends running RUNSTATS:

- The number of inserted and deleted index entries since the last RUNSTATS on an index space or partition, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *SRIInsDelPct*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRIInsDelAbs*

SRIInsDelPct is an input parameter of type DOUBLE. The default is **20.0**. A negative value turns off this criterion.

SRIInsDelAbs
Is the total number of inserted and deleted index entries. Specifies, when combined with *SRIInsDelPct*, a criterion for recommending that the RUNSTATS utility is to be run on an index space. If the following condition is true, DSNACCOX recommends running RUNSTATS:

- The number of inserted and deleted index entries since the last RUNSTATS on an index space or partition, divided by the total number of index entries in the index space or partition (expressed as a percentage) is greater than *SRIInsDelPct*
- The sum of the number of inserted and deleted index entries since the last RUNSTATS on an index space or partition is greater than *SRIInsDelAbs*,

SRIInsDelAbs is an input parameter of type INTEGER. The default is **0**.

SRIMassDelLimit
Is the sum of the number of mass deletes. Specifies a criterion for recommending that the RUNSTATS utility is to be run on an index space. If the number of mass deletes from an index space or partition since the last REORG, REBUILD INDEX, or LOAD REPLACE is greater than this value, DSNACCOX recommends running RUNSTATS.

SRIMassDelLimit is an input parameter of type INTEGER. The default value is **0**. A negative value turns off this criterion.

ExtentLimit
Is the number of physical extents. Specifies a criterion for recommending that the REORG utility is to be run on a table space or index space. Also specifies that DSNACCOX is to warn the user that the table space or index space has used too many extents. DSNACCOX recommends running REORG, and altering data set allocations if the following condition is true:

- The number of physical extents in the index space, table space, or partition is greater than *ExtentLimit*.

ExtentLimit is an input parameter of type INTEGER. The default value is **254**. A negative value turns off this criterion.

LastStatement
When DSNACCOX returns a severe error (return code 12), this field contains the SQL statement that was executing when the error occurred. *LastStatement* is an output parameter of type VARCHAR(8012).

ReturnCode
The return code from DSNACCOX execution. Possible values are:

0 DSNACCOX executed successfully.

4 DSNACCOX completed with a warning. The *ErrorMsg* parameter contains the input parameters that might be incompatible.

8 DSNACCOX terminated with errors. The *ErrorMsg* parameter contains a message that describes the error.

12 DSNACCOX terminated with severe errors. The *ErrorMsg* parameter contains a message that describes the error. The *LastStatement* parameter contains the SQL statement that was executing when the error occurred.

14 DSNACCOX terminated because the real-time statistics table were not yet migrated to the catalog.

15 DSNACCOX terminated because it encountered a problem with one of the declared temporary tables that it defines and uses.

16 DSNACCOX terminated because it could not define a declared temporary table.

NULL DSNACCOX terminated but could not set a return code.

ReturnCode is an output parameter of type INTEGER.

ErrorMsg
Contains information about DSNACCOX execution when DSNACCOX terminates with a non-zero value for *ReturnCode*.

IFCARetCode
Contains the return code from an IFI COMMAND call. DSNACCOX issues commands through the IFI interface to determine the status of objects. *IFCARetCode* is an output parameter of type INTEGER.

IFCAResCode
Contains the reason code from an IFI COMMAND call. *IFCAResCode* is an output parameter of type INTEGER.

XsBytes
Contains the number of bytes of information that did not fit in the IFI return area after an IFI COMMAND call. *XsBytes* is an output parameter of type INTEGER.

DSNACCOX formulas for recommending actions

The following formulas specify the criteria that DSNACCOX uses for its recommendations and warnings. The variables in italics are DSNACCOX input parameters. The capitalized variables are columns of the SYSIBM.SYSTABLESPACESTATS or SYSIBM.SYSINDEXSPACESTATS catalog tables.

The following figure shows the formula that DSNACCOX uses to recommend a full image copy on a table space.

```
| (((QueryType='COPY' OR QueryType='ALL') AND
|  (ObjectType='TS' OR ObjectType='ALL') AND
|  (Object is not in Persistent Read Only (PRO) status) AND
| (ICType='F' OR ICType='B')) AND
|  (COPYLASTTIME IS NULL OR
|   REORGLASTTIME>COPYLASTTIME OR
|   LOADRLASTTIME>COPYLASTTIME OR
|  (CURRENT DATE-COPYLASTTIME)>CRDaySncLastCopy OR
|  ((COPYUPDATEDPAGES
| ×100)/NACTIVE>CRUpdatedPagesPct AND
|   (COPYUPDATEDPAGES>CRupdatedPagesAbs)) OR
|  (COPYCHANGES×100)/TOTALROWS>ICRChangesPct) OR
|  ((QueryType='RESTRICT' OR QueryType='ALL' OR
| QueryType='COPY') AND
|   (ObjectType='TS' OR ObjectType='ALL') AND
| The table space is in COPY-pending status or informational COPY-pending status))
```

Figure 150. DSNACCOX formula for recommending a full image copy on a table space

The following figure shows the formula that DSNACCOX uses to recommend a full image copy on an index space.

```
(((QueryType='COPY' OR QueryType='ALL') AND
  (ObjectType='IX' OR ObjectType='ALL') AND

  (SYSINDEXES.COPY = 'Y')) AND
 (COPYLASTTIME IS NULL OR
  REORGLASTTIME>COPYLASTTIME OR
  LOADRLASTTIME>COPYLASTTIME OR
  REBUILDLASTTIME>COPYLASTTIME OR
  (CURRENT DATE-COPYLASTTIME)>CRDaySncLastCopy OR
  (NACTIVE>CRIndexSize AND
  (((COPYUPDATEDPAGES
×100)/NACTIVE>CRUpdatedPagesPct) AND
   (COPYUPDATEDPAGES>CRUpdatedPagesAbs)) OR
  (COPYCHANGES
×100)/TOTALENTRIES>CRChangesPct)) OR
|  ((QueryType='RESTRICT' OR QueryType='ALL' OR QueryType='COPY') AND
(ObjectType='IX' OR ObjectType='ALL') AND
The index space is in COPY-pending status or informational COPY-pending status))
```

Figure 151. DSNACCOX formula for recommending a full image copy on an index space

The following figure shows the formula that DSNACCOX uses to recommend an incremental image copy on a table space.

```
| ((QueryType='COPY' OR QueryType='ALL') AND
|   (ObjectType='TS' OR ObjectType='ALL') AND
|   (Object is not in Persistent Read Only (PRO) status) AND
| (ICType='F' OR ICType='B')) AND
| (ICType='I') AND
|   COPYLASTTIME IS NOT NULL) AND
| (LOADRLASTTIME>COPYLASTTIME OR
|   REORGLASTTIME>COPYLASTTIME OR
|     ((COPYUPDATEDPAGES
| ×100)/NACTIVE>ICRUpdatedPagesPct) AND
|      (COPYUPDATEDPAGES>ICRUpdatedPagesAbs)) OR
|     (COPYCHANGES
| ×100)/TOTALROWS>ICRChangesPct)
```

Figure 152. DSNACCOX formula for recommending an incremental image copy on a table space

The following figure shows the formula that DSNACCOX uses to recommend a REORG on a table space. If the table space is a LOB table space, and CHKLVL=1, the formula does not include EXTENTS>*ExtentLimit*.

```
| (((QueryType='REORG' OR QueryType='ALL') AND
|    (ObjectType='TS' OR ObjectType='ALL')) AND
|   (Object is not in Persistent Read Only (PRO) status) AND
| ( REORGLASTTIME IS NULL AND LOADRLASTTIME IS NULL) OR
|   (NACTIVE IS NULL OR NACTIVE > 5) AND
|   ((((REORGINSERTS
| ×100)/TOTALROWS>RRTInsertsPct) AND
|      REORGINSERTS>RRTInsertsAbs) OR
|     (((REORGDELETE
| ×100)/TOTALROWS>RRTDeletesPct) AND
|      REORGDELETE>RRTDeletesAbs) OR
|     (REORGCLUSTERSENS > 0 AND  (REORGUNCLUSTINS
| ×100)/TOTALROWS>RRTUnclustInsPct) OR
|     (REORGDISORGLOB
| ×100)/TOTALROWS>RRTDisorgLOBPct OR
|     (SPACE
| ×1024)/DATASIZE>RRTDataSpaceRat OR
|     ((REORGNEARINDREF+REORGFARINDREF)
| ×100)/TOTALROWS>RRTIndRefLimit OR
|     REORGMASSDELETE>RRTMassDelLimit OR
|   EXTENTS>ExtentLimit)) OR
| ((QueryType='REORG' OR QueryType='ALL') AND
|    ObjectType='ALL'[1] AND
|    overflow index for hash access is used[2], and
|    (overflow index TOTALENTRY x 100) / TOTALROWS > RRTHashOvrFlwRatio)) OR
|   ((QueryType='RESTRICT' OR QueryType='ALL' OR QueryType='REORG') AND
|    (ObjectType='TS' OR ObjectType='ALL') AND
|    The table space is in advisory or informational reorg pending status)
```

Notes:

1. Both IX and TS must be selected, thus *ObjectType*=ALL must be specified to use this criteria. If only TS or IX is specified, and the value of the special parameter contains a plus sign (+) to indicate that the RRTHASHOVRFLWRAT column is to be included in the result set, an error message is issued. Otherwise, this criteria is does not apply when only TS or IX is specified.
2. The overflow index is used when SYSINDEXES.HASH = 'Y' AND SYSINDEXSPACESTATS.REORGINDEXACCESS > 0.

Figure 153. DSNACCOX formula for recommending a REORG on a table space

The following figure shows the formula that DSNACCOX uses to recommend a REORG on an index space.

```
(((QueryType='REORG' OR QueryType='ALL') AND
  (ObjectType='IX' OR ObjectType='ALL') AND
  (REORGLASTTIME IS NULL AND REBUILDLASTTIME IS NULL) OR
  (NACTIVE IS NULL OR NACTIVE > 5) AND
  ((((REORGINSERTS
×100)/TOTALENTRIES>RRIInsertsPct) AND
    REORGINSERTS>RRIInsertsAbs) OR
   (((REORGDELETE
×100)/TOTALENTRIES>RRIDeletesPct) AND
    REORGDELETE>RRIDeletesAbs) OR
   (REORGAPPENDINSERT
×100)/TOTALENTRIES>RRIAppendInsertPct OR
   (REORGPSEUDODELETES
×100)/TOTALENTRIES>RRIPseudoDeletePct OR
   REORGMASSDELETE>RRIMassDeleteLimit OR
   (REORGLEAFFAR
×100)/NACTIVE>RRILeafLimit OR
   REORGNUMLEVELS>RRINumLevelsLimit OR
(NPAGES>5 AND
(NPAGES*100)/NLEAF>RRIEmptyLimit) OR
   EXTENTS>ExtentLimit)) OR
 ((QueryType='RESTRICT' OR QueryType='ALL' OR QueryType='REORG') AND
  (ObjectType='IX' OR ObjectType='ALL') AND
  An index is in advisory-REBUILD-pending stats (ARBDP)))
```

Figure 154. DSNACCOX formula for recommending a REORG on an index space

The following figure shows the formula that DSNACCOX uses to recommend RUNSTATS on a table space.

```
((QueryType='RUNSTATS' OR QueryType='ALL') AND
 (ObjectType='TS' OR ObjectType='ALL') AND
 Table Space is not cloned) AND
 (STATSLASTTIME IS NULL OR
  STATSLASTTIME<LOADRLASTTIME OR
  STATSLASTTIME<REORGLASTTIME OR
  STATSLASTTIME< latest PROFILE_UPDATE for the table space[1] OR
  (((STATSINSERTS+STATSDELETES+STATSUPDATES)
×100)/TOTALROWS>SRTInsDelUpdPct AND
    (STATSINSERTS+STATSDELETES+STATSUPDATES)>SRTInsDelUpdAbs) OR
  STATSMASSDELETE>SRTMassDeleteLimit)))
```

Figure 155. DSNACCOX formula for recommending RUNSTATS on a table space

Notes:

1. PROFILE_UPDATE is a table-level timestamp column in the SYSIBM.SYSTABLES_PROFILES catalog table. It is updated by RUNSTATS SET or UPDATE. The PROFILE_UPDATE value is not returned as a column in the DSNACCOX result set.

The following figure shows the formula that DSNACCOX uses to recommend RUNSTATS on an index space.

```
((QueryType='RUNSTATS' OR QueryType='ALL') AND
 (ObjectType='IX' OR ObjectType='ALL')
 Table Space for the index is not cloned ) AND
 (STATSLASTTIME IS NULL OR
  STATSLASTTIME<LOADRLASTTIME OR
  STATSLASTTIME<REORGLASTTIME OR
  (((STATSINSERTS+STATSDELETES)
×100)/TOTALENTRIES>SRIInsDelPct AND
    (STATSINSERTS+STATSDELETES)>SRIInsDelAbs) OR
  STATSMASSDELETE>SRIInsDelAbs)))
```

Figure 156. DSNACCOX formula for recommending RUNSTATS on an index space

Using an exception table

An exception table is an optional, user-created DB2 table that you can use to place information in the INEXCEPTTABLE column of the recommendations result set. You can put any information in the INEXCEPTTABLE column, but the most common use of this column is to filter the recommendations result set. Each row in the exception table represents an object for which you want to provide information for the recommendations result set.

To create the exception table, execute a CREATE TABLE statement similar to the following one. You can include other columns in the exception table, but you must include at least the columns that are shown.

```
CREATE TABLE DSNACC.EXCEPT_TBL
 (DBNAME CHAR(8) NOT NULL,
  NAME CHAR(8) NOT NULL,
  QUERYTYPE CHAR(40))
 CCSID EBCDIC;
```

The meanings of the columns are:

DBNAME
The database name for an object in the exception table.

NAME
The table space name or index space name for an object in the exception table.

QUERYTYPE
The information that you want to place in the INEXCEPTTABLE column of the recommendations result set.

If you put a null value in this column, DSNACCOX puts the value YES in the INEXCEPTTABLE column of the recommendations result set row for the object that matches the DBNAME and NAME values.

Recommendation: If you plan to put many rows in the exception table, create a nonunique index on DBNAME, NAME, and QUERYTYPE.

After you create the exception table, insert a row for each object for which you want to include information in the INEXCEPTTABLE column.

Example: Suppose that you want the INEXCEPTTABLE column to contain the string 'IRRELEVANT' for table space STAFF in database DSNDB04. You also want the INEXCEPTTABLE column to contain 'CURRENT' for table space DSN8S11D in database DSN8D11A. Execute these INSERT statements:

```
INSERT INTO DSNACC.EXCEPT_TBL VALUES('DSNDB04 ', 'STAFF ', 'IRRELEVANT');
INSERT INTO DSNACC.EXCEPT_TBL VALUES('DSN8D11A', 'DSN8S11D', 'CURRENT');
```

To use the contents of INEXCEPTTABLE for filtering, include a condition that involves the INEXCEPTTABLE column in the search condition that you specify in your *Criteria* input parameter.

Example: Suppose that you want to include all rows for database DSNDB04 in the recommendations result set, except for those rows that contain the string 'IRRELEVANT' in the INEXCEPTTABLE column. You might include the following search condition in your *Criteria* input parameter:

```
DBNAME='DSNDB04' AND INEXCEPTTABLE<>'IRRELEVANT'
```

Example

The following figure is a COBOL example that shows variable declarations and an SQL CALL for obtaining recommendations for objects in databases DSN8D11A and DSN8D11L. This example also outlines the steps that you need to perform to retrieve the two result sets that DSNACCOX returns. These result sets are described in "DSNACCOX output" on page 1093

```
 WORKING-STORAGE SECTION.
**********************
* DSNACCOX PARAMETERS *
**********************
 01  QUERYTYPE.
     49   QUERYTYPE-LN        PICTURE S9(4) COMP VALUE 40.
     49   QUERYTYPE-DTA       PICTURE X(40)  VALUE 'ALL'.
 01  OBJECTTYPE.
     49   OBJECTTYPE-LN       PICTURE S9(4) COMP VALUE 3.
     49   OBJECTTYPE-DTA      PICTURE X(3)  VALUE 'ALL'.
 01  ICTYPE.
     49   ICTYPE-LN           PICTURE S9(4) COMP VALUE 1.
     49   ICTYPE-DTA          PICTURE X(1)  VALUE 'B'.
 01  CATLGSCHEMA.
 49   CATLGSCHEMA-LN      PICTURE S9(4) COMP VALUE 128.
     49   CATLGSCHEMA-DTA     PICTURE X(128)  VALUE 'SYSIBM'.
 01  LOCALSCHEMA.
     49   LOCALSCHEMA-LN      PICTURE S9(4) COMP VALUE 128.
     49   LOCALSCHEMA-DTA     PICTURE X(128)  VALUE 'DSNACC'.
 01  CHKLVL                   PICTURE S9(9) COMP VALUE +3.
 01  CRITERIA.
     49   CRITERIA-LN         PICTURE S9(4) COMP VALUE 4096.
     49   CRITERIA-DTA        PICTURE X(4096)  VALUE SPACES.
 01  SPECIALPARM.
     49   SPECIALPARM-LN       PICTURE S9(4) COMP VALUE 80.
     49   SPECIALPARM-DTA      PICTURE X(80)  VALUE SPACES.
 01  CRUPDATEDPAGESPCT        USAGE COMP-2 VALUE +0.
 01  CRUPDATEDPAGESABS        PICTURE S9(9) COMP VALUE +0.
 01  CRCHANGESPCT             USAGE COMP-2 VALUE +0.
 01  CRDAYSNCLASTCOPY         PICTURE S9(9) COMP VALUE +0.
 01  ICRUPDATEDPAGESPCT       USAGE COMP-2 VALUE +0.
 01  ICRUPDATEDPAGESABS       PICTURE S9(9) COMP VALUE +0.
 01  ICRCHANGESPCT            PICTURE S9(9) COMP VALUE +0.
 01  CRINDEXSIZE              PICTURE S9(9) COMP VALUE +0.
 01  RRTINSERTSPCT             USAGE COMP-2 VALUE +0.
 01  RRTINSERTSABS             PICTURE S9(9) COMP VALUE +0.
 01  RRTDELETESPCT             USAGE COMP-2 VALUE +0.
 01  RRTDELETESABS             PICTURE S9(9) COMP VALUE +0.
 01  RRTUNCLUSTINSPCT         USAGE COMP-2 VALUE +0.
 01  RRTDISORGLOBPCT          USAGE COMP-2 VALUE +0.
 01  RRTDATASPACERAT          PICTURE S9(9) COMP VALUE +0.
 01  RRTMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  RRTINDREFLIMIT           PICTURE S9(9) COMP VALUE +0.
 01  RRIINSERTSPCT             USAGE COMP-2 VALUE +0.
 01  RRIINSERTSABS             PICTURE S9(9) COMP VALUE +0.
 01  RRIDELETESPCT             USAGE COMP-2 VALUE +0.
```

```
 01  RRIDELETESABS             PICTURE S9(9) COMP VALUE +0.
 01  RRIAPPENDINSERTPCT       USAGE COMP-2 VALUE +0.
 01  RRIPSEUDODELETEPCT       USAGE COMP-2 VALUE +0.
 01  RRIMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  RRILEAFLIMIT             PICTURE S9(9) COMP VALUE +0.
 01  RRINUMLEVELSLIMIT        PICTURE S9(9) COMP VALUE +0.
 01  SRTINSDELUPDPCT          PICTURE S9(9) COMP VALUE +0.
 01  SRTINSDELUPDABS          PICTURE S9(9) COMP VALUE +0.
 01  SRTMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  SRIINSDELPCT             USAGE COMP-2 VALUE +0.
 01  SRIINSDELABS             PICTURE S9(9) COMP VALUE +0.
 01  SRIMASSDELLIMIT          PICTURE S9(9) COMP VALUE +0.
 01  EXTENTLIMIT              PICTURE S9(9) COMP VALUE +0.
 01  LASTSTATEMENT.
     49   LASTSTATEMENT-LN    PICTURE S9(4) COMP VALUE 8012.
     49   LASTSTATEMENT-DTA   PICTURE X(8012)  VALUE SPACES.
 01  RETURNCODE               PICTURE S9(9) COMP VALUE +0.
 01  ERRORMSG.
     49   ERRORMSG-LN         PICTURE S9(4) COMP VALUE 1331.
     49   ERRORMSG-DTA        PICTURE X(1331)  VALUE SPACES.
 01  IFCARETCODE              PICTURE S9(9) COMP VALUE +0.
 01  IFCARESCODE              PICTURE S9(9) COMP VALUE +0.
 01  XSBYTES             PICTURE S9(9) COMP VALUE +0.
****************************************
* INDICATOR VARIABLES.                 *
* INITIALIZE ALL NON-ESSENTIAL INPUT   *
* VARIABLES TO -1, TO INDICATE THAT THE *
* INPUT VALUE IS NULL.                 *
****************************************
 01  QUERYTYPE-IND            PICTURE S9(4) COMP-4 VALUE +0.
 01  OBJECTTYPE-IND           PICTURE S9(4) COMP-4 VALUE +0.
 01  ICTYPE-IND               PICTURE S9(4) COMP-4 VALUE +0.
 01  CATLGSCHEMA-IND          PICTURE S9(4) COMP-4 VALUE -1.
 01  LOCALSCHEMA-IND          PICTURE S9(4) COMP-4 VALUE -1.
 01  CHKLVL-IND               PICTURE S9(4) COMP-4 VALUE -1.
 01  CRITERIA-IND             PICTURE S9(4) COMP-4 VALUE -1.
 01  SPECIALPARM-IND           PICTURE S9(4) COMP-4 VALUE -1.
 01  CRUPDATEDPAGESPCT-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  CRUPDATEDPAGESABS-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  CRCHANGESPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  CRDAYSNCLASTCOPY-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  ICRUPDATEDPAGESPCT-IND   PICTURE S9(4) COMP-4 VALUE -1.
 01 ICRUPDATEDPAGESABS-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  ICRCHANGESPCT-IND        PICTURE S9(4) COMP-4 VALUE -1.
 01  CRINDEXSIZE-IND          PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTINSERTSPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTINSERTSABS-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTDELETESPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTDELETESABS-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTUNCLUSTINSPCT-IND     PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTDISORGLOBPCT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTDATASPACERAT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTMASSDELLIMIT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  RRTINDREFLIMIT-IND       PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIINSERTSPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIINSERTSABS-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIDELETESPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIDELETESABS-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIAPPENDINSERTPCT-IND   PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIPSEUDODELETEPCT-IND   PICTURE S9(4) COMP-4 VALUE -1.
 01  RRIMASSDELLIMIT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  RRILEAFLIMIT-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  RRINUMLEVELSLIMIT-IND    PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTINSDELUPDPCT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTINSDELUPDABS-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  SRTMASSDELLIMIT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  SRIINSDELPCT-IND         PICTURE S9(4) COMP-4 VALUE -1.
```

```
 01  SRIINSDELABS-IND         PICTURE S9(4) COMP-4 VALUE -1.
 01  SRIMASSDELLIMIT-IND      PICTURE S9(4) COMP-4 VALUE -1.
 01  EXTENTLIMIT-IND          PICTURE S9(4) COMP-4 VALUE -1.
 01  LASTSTATEMENT-IND        PICTURE S9(4) COMP-4 VALUE +0.
 01  RETURNCODE-IND           PICTURE S9(4) COMP-4 VALUE +0.
 01  ERRORMSG-IND             PICTURE S9(4) COMP-4 VALUE +0.
 01  IFCARETCODE-IND          PICTURE S9(4) COMP-4 VALUE +0.
 01  IFCARESCODE-IND          PICTURE S9(4) COMP-4 VALUE +0.
 01  XSBYTES-IND          PICTURE S9(4) COMP-4 VALUE +0
PROCEDURE DIVISION.
*******************************************************
* SET VALUES FOR DSNACCOX INPUT PARAMETERS:           *
* - USE THE CHKLVL PARAMETER TO CAUSE DSNACCOX TO CHECK *
*   FOR RELATED TABLE SPACES WHEN PROCESSING INDEX    *
*   SPACES, AND DELETE RECOMMENDATION FOR INDEXSPACES *
*   WHEN AN ACTION (SUCH AS REORG) ON THE TABLE SPACE *
*   WILL ALSO CAUSE THE ACTION TO BE DONE ON THE INDEX *
*   SPACE. (CHKLVL=64)                                *
* - USE THE CRITERIA PARAMETER TO CAUSE DSNACCOX TO   *
*   MAKE RECOMMENDATIONS ONLY FOR OBJECTS IN DATABASES *
*   DSN8D91A AND DSN8D91L.                            *
* - FOR THE FOLLOWING PARAMETERS, SET THESE VALUES,   *
*   WHICH ARE LOWER THAN THE DEFAULTS:                *
*   CRUPDATEDPAGESPCT   4                             *
*   CRCHANGESPCT        2                             *
*   RRTINSDELUPDPCT     2                             *
*   RRTUNCLUSTINSPCT    5                             *
*   RRTDISORGLOBPCT     5                             *
*   RRIAPPENDINSERTPCT  5                             *
*   SRTINSDELUPDPCT     5                             *
*   SRIINSDELPCT        5                             *
*   EXTENTLIMIT         3                             *
* - EXCLUDE CHECKING FOR THESE CRITERIA BY SET THE    *
*   FOLLOWING VALUES TO A NEGATIVE VALUE.             *
*   RRTMASSDELLIMIT     -1                            *
*   RRIMASSDELLIMIT     -1                            *
*******************************************************
     MOVE 64 TO CHKLVL.
     MOVE SPACES TO CRITERIA-DTA.
     MOVE 'DBNAME = ''DSN8D91A'' OR DBNAME = ''DSN8D91L'''
           TO CRITERIA-DTA.
     MOVE 46 TO CRITERIA-LN.
     MOVE 4 TO CRUPDATEDPAGESPCT.
     MOVE 2 TO CRCHANGESPCT.
     MOVE 2 TO RRTINSERTSPCT.
     MOVE 5 TO RRTUNCLUSTINSPCT.
     MOVE 5 TO RRTDISORGLOBPCT.
     MOVE 5 TO RRIAPPENDINSERTPCT.
     MOVE 5 TO SRTINSDELUPDPCT.
     MOVE 5 TO SRIINSDELPCT
     MOVE 3 TO EXTENTLIMIT.
     MOVE -1 TO RRTMASSDELLIMIT.
     MOVE -1 TO RRIMASSDELLIMIT.
*********************************
* INITIALIZE OUTPUT PARAMETERS *
*********************************
     MOVE SPACES TO LASTSTATEMENT-DTA.
     MOVE 1 TO LASTSTATEMENT-LN.
     MOVE 0 TO RETURNCODE-O2.
     MOVE SPACES TO ERRORMSG-DTA.
     MOVE 1 TO ERRORMSG-LN.
     MOVE 0 TO IFCARETCODE.
     MOVE 0 TO IFCARESCODE.
     MOVE 0 TO XSBYTES.
*******************************************************
* SET THE INDICATOR VARIABLES TO 0 FOR NON-NULL INPUT *
* PARAMETERS (PARAMETERS FOR WHICH YOU DO NOT WANT    *
```

```
* DSNACCOX TO USE DEFAULT VALUES) AND FOR OUTPUT      *
* PARAMETERS.                                         *
*******************************************************
     MOVE 0 TO CHKLVL-IND.
     MOVE 0 TO CRITERIA-IND.
     MOVE 0 TO CRUPDATEDPAGESPCT-IND.
     MOVE 0 TO CRCHANGESPCT-IND.
     MOVE 0 TO RRTINSERTSPCT-IND.
     MOVE 0 TO RRTUNCLUSTINSPCT-IND.
     MOVE 0 TO RRTDISORGLOBPCT-IND.
     MOVE 0 TO RRIAPPENDINSERTPCT-IND.
     MOVE 0 TO SRTINSDELUPDPCT-IND.
     MOVE 0 TO SRIINSDELPCT-IND.
     MOVE 0 TO EXTENTLIMIT-IND.
     MOVE 0 TO LASTSTATEMENT-IND.
     MOVE 0 TO RETURNCODE-IND.
     MOVE 0 TO ERRORMSG-IND.
     MOVE 0 TO IFCARETCODE-IND.
     MOVE 0 TO IFCARESCODE-IND.
     MOVE 0 TO XSBYTES-IND.
     MOVE 0 TO RRTMASSDELLIMIT-IND.
     MOVE 0 TO RRIMASSDELLIMIT-IND.

*****************
* CALL DSNACCOX *
*****************
     EXEC SQL
      CALL SYSPROC.DSNACCOX
      (:QUERYTYPE           :QUERYTYPE-IND,
       :OBJECTTYPE          :OBJECTTYPE-IND,
       :ICTYPE              :ICTYPE-IND,
       :CATLGSCHEMA         :CATLGSCHEMA-IND,
       :LOCALSCHEMA         :LOCALSCHEMA-IND,
       :CHKLVL              :CHKLVL-IND,
       :CRITERIA            :CRITERIA-IND,
       :SPECIALPARM          :SPECIALPARM-IND,
       :CRUPDATEDPAGESPCT   :CRUPDATEDPAGESPCT-IND,
       :CRUPDATEDPAGESABS   :CRUPDATEDPAGESABS-IND,
       :CRCHANGESPCT        :CRCHANGESPCT-IND,
       :CRDAYSNCLASTCOPY    :CRDAYSNCLASTCOPY-IND,
       :ICRUPDATEDPAGESPCT  :ICRUPDATEDPAGESPCT-IND,
       :ICRUPDATEDPAGESABS  :ICRUPDATEDPAGESABS-IND,
       :ICRCHANGESPCT       :ICRCHANGESPCT-IND,
       :CRINDEXSIZE         :CRINDEXSIZE-IND,
       :RRTINSERTSPCT        :RRTINSERTSPCT-IND,
       :RRTINSERTSABS       :RRTINSERSTSABS-IND,
       :RRTDELETESPCT        :RRTDELETESPCT-IND,
       :RRTDELETESABS        :RRTDELETESABS-IND,
       :RRTUNCLUSTINSPCT    :RRTUNCLUSTINSPCT-IND,
       :RRTDISORGLOBPCT     :RRTDISORGLOBPCT-IND,
       :RRTDATASPACERAT     :RRTDATASPACERAT-IND,
       :RRTMASSDELLIMIT     :RRTMASSDELLIMIT-IND,
       :RRTINDREFLIMIT      :RRTINDREFLIMIT-IND,
       :RRIINSERTSPCT        :RRIINSERTSPCT-IND,
       :RRIINSERTSABS        :RRIINSERTSABS-IND,
       :RRIDELETESPCT        :RRIDELETESPCT-IND,
       :RRIDELETESABS        :RRIDELETESABS-IND,
       :RRIAPPENDINSERTPCT  :RRIAPPENDINSERTPCT-IND,
       :RRIPSEUDODELETEPCT  :RRIPSEUDODELETEPCT-IND,
       :RRIMASSDELLIMIT     :RRIMASSDELLIMIT-IND,
       :RRILEAFLIMIT        :RRILEAFLIMIT-IND,
       :RRINUMLEVELSLIMIT   :RRINUMLEVELSLIMIT-IND,
       :SRTINSDELUPDPCT     :SRTINSDELUPDPCT-IND,
       :SRTINSDELUPDABS     :SRTINSDELUPDABS-IND,
       :SRTMASSDELLIMIT     :SRTMASSDELLIMIT-IND,
       :SRIINSDELPCT        :SRIINSDELPCT-IND,
       :SRIINSDELABS        :SRIINSDELABS-IND,
       :SRIMASSDELLIMIT     :SRIMASSDELLIMIT-IND,
```

```
       :EXTENTLIMIT         :EXTENTLIMIT-IND,
       :LASTSTATEMENT       :LASTSTATEMENT-IND,
       :RETURNCODE          :RETURNCODE-IND,
       :ERRORMSG            :ERRORMSG-IND,
       :IFCARETCODE         :IFCARETCODE-IND,
       :IFCARESCODE         :IFCARESCODE-IND,
       :XSBYTES          :XSBYTES-IND)
     END-EXEC.
************************************************************
* ASSUME THAT THE SQL CALL RETURNED +466, WHICH MEANS THAT  *
* RESULT SETS WERE RETURNED. RETRIEVE RESULT SETS.          *
************************************************************
* LINK EACH RESULT SET TO A LOCATOR VARIABLE
     EXEC SQL ASSOCIATE LOCATORS (:LOC1, :LOC2)
       WITH PROCEDURE SYSPROC.DSNACCOX
     END-EXEC.
* LINK A CURSOR TO EACH RESULT SET
     EXEC SQL ALLOCATE C1 CURSOR FOR RESULT SET :LOC1
     END-EXEC.
     EXEC SQL ALLOCATE C2 CURSOR FOR RESULT SET :LOC2
     END-EXEC.
* PERFORM FETCHES USING C1 TO RETRIEVE ALL ROWS FROM FIRST RESULT SET
* PERFORM FETCHES USING C2 TO RETRIEVE ALL ROWS FROM SECOND RESULT SET
```

DSNACCOX output

If DSNACCOX executes successfully, in addition to the output parameters described in "Option descriptions" on page 1072, DSNACCOX returns two result sets.

The first result set contains the results from IFI COMMAND calls that DSNACCOX makes. The following table shows the format of the first result set.

Table 149. Result set row for first DSNACCOX result set

Column name	Data type	Contents
RS_SEQUENCE	INTEGER	Sequence number of the output line
RS_DATA	CHAR(80)	A line of command output

The second result set contains rows for table spaces, index spaces, or partitions, if both of the following conditions are true for the object:

- If the *Criteria* input parameter contains a search condition, and the search condition is true for the table space, index space, or partition.
- DSNACCOX recommends at least one action for the table space, index space, or partition.

The second result set contains one row for each nonpartitioned table space or nonpartitioning index space. For partitioned table spaces or partitioning indexes, the result set contains one row for each partition.

The following table shows the columns of a result set row.

Table 150. Result set row for second DSNACCOX result set

Column name	Data type[1]	Description
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the object.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
NAME	VARCHAR(128) NOT NULL	Table space name, index name, or index space name. Index space name is used if the row is added as a result of checking a restricted state and the index name is not available at the time.
PARTITION	INTEGER NOT NULL	Data set number or partition number.
INSTANCE	SMALLINT NOT NULL	Indicates whether the object is associated with a data set instance.
CLONE	CHAR(1)	'Y' or 'N', 'Y' indicates a cloned object.
OBJECTTYPE	CHAR(2) NOT NULL	DB2 object type: • 'TS' for a table space • 'IX' for an index space • 'LS' for an LOB table space • 'XS' for an XML table space
INDEXSPACE	VARCHAR(24)	Index space name.
CREATOR	VARCHAR(128)	Index creator name.
OBJECTSTATUS	CHAR(40)	Status of the object: • ORPHANED, if the object is an index space with no corresponding table space, or if the object does not exist • If the object is in a restricted state, one of the following values: – TS=*restricted-state*, if OBJECTTYPE is TS – IX=*restricted-state*, if OBJECTTYPE is IX – LS=*restricted-state*, if OBJECTTYPE is LS – LX=*restricted-state*, if OBJECTTYPE is XS *restricted-state* is one of the status codes that appear in the output of the DISPLAY DATABASE command. **Related information:** DSNT362I (DB2 Messages) -DISPLAY DATABASE (DB2) (DB2 Commands) • A, if the object is in an advisory state. • L, if the object is a logical partition, but not in an advisory state. • AL, if the object is a logical partition and in an advisory state.
IMAGECOPY	CHAR(4)	COPY recommendation: • If the object is a table space, one of the following values: **FULL** Full image copy is recommended **INC** Incremental image copy is recommended **NO** Image copy is not recommended. • If the object is an index, whether image copy is recommended: YES or NO

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
RUNSTATS	CHAR(3)	RUNSTATS recommendation: YES, NO, or Y**. Y** indicates that the table space contains volatile and non-volatile tables.
EXTENTS	CHAR(3)	Indicates whether the data sets for the object have exceeded *ExtentLimit*: YES or NO.
REORG	CHAR(3)	REORG recommendation: YES or NO.
INEXCEPTTABLE	CHAR(40)	A string that contains one of the following values: • Text that you specify in the QUERYTYPE column of the exception table. • YES, if you put a row in the exception table for the object that this result set row represents, but you specify NULL in the QUERYTYPE column. • NO, if the exception table exists but does not have a row for the object that this result set row represents. • Null, if the exception table does not exist, or if the *ChkLvl* input parameter does not include the value 4.
ASSOCIATEDTS	VARCHAR(128)	If OBJECTTYPE is IX this value is the name of the table space that is associated with the index space. Otherwise null.
COPYLASTTIME	TIMESTAMP	Timestamp of the last full or incremental image copy on the object. Null if COPY was never run, or if the last COPY execution is unknown.
LOADRLASTTIME	TIMESTAMP	Timestamp of the last LOAD REPLACE on the object. Null if LOAD REPLACE was never run, or if the last LOAD REPLACE execution is unknown.
REBUILDLASTTIME	TIMESTAMP	Timestamp of the last REBUILD INDEX on the object. Null if REBUILD INDEX was never run, or if the last REBUILD INDEX execution is unknown.
CRUPDPGSPCT	DOUBLE	If IMAGECOPY contains a value other than NO, the ratio of distinct updated pages to pre-formatted pages, expressed as a percentage. Otherwise null. If the ratio of distinct updated pages to pre-formatted pages, does not exceed the *CRUpdatedPagesPct* or *ICRUpdatedPagesPct* (for tables spaces only, when incremental copy is recommended), this value is null.
CRUPDPGSABS	INTEGER	If IMAGECOPY contains a value other than NO, the ratio of distinct updated pages to pre-formatted pages. Otherwise null. If the ratio of distinct updated pages to pre-formatted pages, does not exceed the value specified for*CRUpdatedPagesAbs* or *ICRUpdatedPagesAbs* (for tables spaces only, when incremental copy is recommended), this value is null.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
CRCPYCHGPCT	DOUBLE	If the object is a table space and the value of IMAGECOPY is any value other than NO, the ratio of the total number insert, update, and delete operations since the last image copy to the total number of rows or LOBs in the table space or partition, expressed as a percentage. If the object is an index and IMAGECOPY is YES, the ratio of the total number of insert and delete operations since the last image copy to the total number of entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number insert, update, and delete operations since the last image copy to the total number of rows or LOBs in the table space or partition does not exceed the value specified for*CRChangesPct* or *ICRChangesPct* (incremental copy is recommended), this value is null.
CRDAYSCELSTCPY	INTEGER	If IMAGECOPY is YES, the number of days since the last image copy. Otherwise null. If the number of days since the last image copy does not exceed the value specified for *CrDaySncLastCopy*, this value is null.
CRINDEXSIZE	INTEGER	If IMAGECOPY is YES, the number of active pages in the index space or partition. Otherwise null. If the number of active pages in the index space or partition does not exceed the value specified for *CRIndexSize*, this value is null.
REORGLASTTIME	TIMESTAMP	Timestamp of the last REORG on the object. Null if REORG was never run, or if the last REORG execution was terminated.
RRTINSERTSPCT	DOUBLE	If REORG is YES, the ratio of the sum of insert operations since the last REORG to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the sum of insert operations since the last REORG to the total number of rows or LOBs in the table space or partition does not exceed the value specified for *RRTInsertsPct*, this value is null.
RRTINSERTSABS	INTEGER	If REORG is YES, the sum of insert operations since the last REORG to the total number of rows in the table space or partition. Otherwise null. If the sum of insert operations since the last REORG to the total number of rows in the table space or partition does not exceed the value specified for *RRTInsertsAbs*, this value is null.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
RRTDELETESPCT	DOUBLE	If REORG is YES, the ratio of the sum of delete operations since the last REORG to the total number of rows in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the sum of delete operations since the last REORG to the total number of rows in the table space or partition does not exceed the value specified for *RRTDeletesPct*, this value is null.
RRTDELETESABS	INTEGER	If REORG is YES, the total number of delete operations since the last REORG on a table space or partition. Otherwise null. If the total number of delete operations since the last REORG does not exceed the value specified for *RRTDeletesAbs*, this value is null.
RRTUNCINSPCT	DOUBLE	If REORG is YES, the ratio of the number of unclustered insert operations to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the number of unclustered insert operations to the total number of rows or LOBs does not exceed the value specified for *RRTUnclustInsPct*, this value is null.
RRTDISORGLOBPCT	DOUBLE	If REORG is YES, the ratio of the number of imperfectly chunked LOBs to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the number of imperfectly chunked LOBs to the total number of rows or LOBs in the table space or partition does not exceed the value of *RRTDisorgLOBPct*, this value is null
RRTDATSPRAT	DOUBLE	If REORG is YES, the ratio of the number of SPACE allocated and the space used, exceed the value specified by the RRTDataSpaceRat threshold. Otherwise null.
RRTMASSDELETE	INTEGER	If REORG is YES, and the table space is a segmented table space or LOB table space, the number of mass deletes since the last REORG or LOAD REPLACE. If REORG is YES, and the table space is nonsegmented, the number of dropped tables since the last REORG or LOAD REPLACE. Otherwise null. If the number of dropped tables since the last REORG or LOAD REPLACE does not exceed the value specified for *RRTMassDelLimit*, this value is null.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
RRTINDREF	DOUBLE	If REORG is YES, the ratio of the total number of overflow records that were created since the last REORG or LOAD REPLACE to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number of overflow records that were created since the last REORG or LOAD REPLACE to the total number of rows or LOBs does not exceed the value specified for *RRTIndRef*, this value is null.
RRIINSERTSPCT	DOUBLE	If REORG is YES, the ratio of the total number of insert operations since the last REORG to the total number of index entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number of insert operations since the last REORG to the total number of index entries does not exceed the value specified for *RRIInsertsPct*, this value is null.
RRIINSERTSABS	INTEGER	If REORG is YES, the total number of insert operations since the last REORG. Otherwise null. If the total number of insert operations since the last REORG does not exceed the value specified for *RRTInsertsAbs*, this value is null.
RRIDELETESPCT	DOUBLE	If REORG is YES, the ratio of the total number of delete operations since the last REORG to the total number of index entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number of delete operations since the last REORG to the total number of index entries does not exceed the value specified for *RRIDeletesPct*, this value is null.
RRIDELETABS	INTEGER	If REORG is YES, the total number of delete operations since the last REORG. Otherwise null. If the total number of delete operations since the last REORG does not exceed the value specified for *RRTDeletesAbs*, this value is null.
RRIAPPINSPCT	DOUBLE	If REORG is YES, the ratio of the number of index entries that were inserted since the last REORG, REBUILD INDEX, or LOAD REPLACE that had a key value greater than the maximum key value in the index space or partition, to the number of index entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the number of index entries that were inserted, which had a key value greater than the maximum key value, to the number of index entries does not exceed the value specified for *RRIAppendInsertPct*, this value is null.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
RRIPSDDELPCT	DOUBLE	If REORG is YES, the ratio of the number of index entries that were pseudo-deleted (the RID entry was marked as deleted) since the last REORG, REBUILD INDEX, or LOAD REPLACE to the number of index entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the number of index entries that were pseudo-deleted since the last REORG, REBUILD INDEX, or LOAD REPLACE to the number of index entries does not exceed the value specified for *RRIPseudoDeletePct*, this value is null.
RRIMASSDELETE	INTEGER	If REORG is YES, the number of mass deletes from the index space or partition since the last REORG, REBUILD, or LOAD REPLACE. Otherwise null. If the number of mass deletes from the index space or partition since the last REORG, REBUILD, or LOAD REPLACE does not exceed the value specified for *RRIMassDelLimit*, this value is null.
RRILEAF	DOUBLE	If REORG is YES, the ratio of the number of index page splits that occurred since the last REORG, REBUILD INDEX, or LOAD REPLACE in which the higher part of the split page was far from the location of the original page, to the total number of active pages in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the number of index page splits that occurred since the last REORG, REBUILD INDEX, or LOAD REPLACE to the total number of active pages does not exceed the value specified for *RRILeafLimit*, this value is null.
RRINUMLEVELS	INTEGER	If REORG is YES, the number of levels in the index tree that were added or removed since the last REORG, REBUILD INDEX, or LOAD REPLACE. Otherwise null. If the number of levels in the index tree that were added or removed does not exceed the value specified for *RRINumLevelsLimit*, this value is null.
STATSLASTTIME	TIMESTAMP	Timestamp of the last RUNSTATS on the object. Null if RUNSTATS was never run, or if the last RUNSTATS execution was unknown.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
SRTINSDELUPDPCT	DOUBLE	If RUNSTATS is YES, the ratio of the total number of insert, update, and delete operations since the last RUNSTATS on a table space or partition, to the total number of rows or LOBs in the table space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number of insert, update, and delete operations since the last RUNSTATS to the total number of rows or LOBs does not exceed the value specified for *SRTInsDelUpdPct*, this value is null.
SRTINSDELUPDABS	INTEGER	If RUNSTATS is YES, the total number of insert, update, and delete operations since the last RUNSTATS on a table space or partition. Otherwise null. If the total number of insert, update, and delete operations since the last RUNSTATS does not exceed the value specified for *SRTInsDelUpdAbs*, this value is null.
SRTMASSDELETE	INTEGER	If RUNSTATS is YES, the number of mass deletes from the table space or partition since the last REORG or LOAD REPLACE. Otherwise null. If the number of mass deletes from the table space or partition since the last REORG or LOAD REPLACE does not exceed the value specified for *SRTMassDelLimit*, this value is null.
SRIINSDELPCT	DOUBLE	If RUNSTATS is YES, the ratio of the total number of insert and delete operations since the last RUNSTATS on the index space or partition, to the total number of index entries in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number of insert and delete operations since the last RUNSTATS, to the total number of index entries does not exceed the value specified for *SRIInsDelPct*, this value is null.
SRIINSDELABS	INTEGER	If RUNSTATS is YES, the number insert and delete operations since the last RUNSTATS on the index space or partition. Otherwise null. If the total number of insert, update, and delete operations since the last RUNSTATS does not exceed the value specified for, this value is null.
SRIMASSDELETE	INTEGER	If RUNSTATS is YES, the number of mass deletes from the index space or partition since the last REORG, REBUILD INDEX, or LOAD REPLACE. Otherwise, this value is null. If the number of mass deletes does not exceed the value specified for *SRIMassDelete*, this value is null.

Table 150. Result set row for second DSNACCOX result set (continued)

Column name	Data type[1]	Description
TOTALEXTENTS	SMALLINT	If EXTENTS is YES, the number of physical extents in the table space, index space, or partition. Otherwise, this value is null. If the number of physical extents does not exceed the value specified for *ExtentLimit*, this value is null.
RRIEMPTYLIMIT	DOUBLE	This column is returned only when the value of *RRIEmptyLimit* contains a plus (+) sign. If *ObjectType* is IX and REORG is YES, the ratio of the total number of leaf pages since the last REORG to the total number of pseudo-empty pages in the index space or partition, expressed as a percentage. Otherwise null. If the ratio of the total number leaf pages since the last REORG to the total number of pseudo-empty pages does not exceed the value specified for the RRIEmptyLimit input parameter, this value is null.
RRTHASHOVRFLWRAT	DOUBLE	This is column is returned only when the value of *RRTHashOvrFlwRatio* contains a plus (+) sign. If REORG is YES, the ratio of Hash Access overflow index entries to the total number of rows, expressed as a percentage. Otherwise null. If the ratio of Hash Access overflow index entries to the total number of rows does not exceed the value specified for *RRTHashOvrFlwRatio* or meet the criteria requirement, this value is null.

1. Columns that are not marked as NOT NULL can contain null values.

PSPI

Maintaining data organization and statistics (DB2 Performance)

Setting up your system for real-time statistics (DB2 Performance)

Chapter 29, “REORG TABLESPACE,” on page 551

Chapter 28, “REORG INDEX,” on page 513

Chapter 33, “RUNSTATS,” on page 737

Implementing DB2 stored procedures (DB2 Administration Guide)

CREATE DATABASE (DB2 SQL)

CREATE TABLESPACE (DB2 SQL)

SYSIBM.SYSTABLESPACESTATS table (DB2 SQL)

SYSIBM.SYSINDEXSPACESTATS table (DB2 SQL)

SYSIBM.SYSTABLES_PROFILES table (DB2 SQL)

Appendix C. Advisory or restrictive states

To control access and help ensure data integrity, DB2 sets a restrictive or nonrestrictive (advisory) status on certain objects. However, you can take steps to correct each status.

Use the **DISPLAY DATABASE** command to display the current status for an object.

In addition to the states mentioned in this topic, the output from the **DISPLAY DATABASE** command might also indicate that an object is in logical page list (LPL) status. This state means that the pages that are listed in the LPL PAGES column are logically in error and are unavailable for access. DB2 writes entries for these pages in an LPL.

Related tasks:

Removing pages from the logical page list (DB2 Administration Guide)

Related reference:

-DISPLAY DATABASE (DB2) (DB2 Commands)

Auxiliary CHECK-pending status

When the auxiliary CHECK-pending status is set on a base table space, that base table space is unavailable for processing by SQL.

The auxiliary CHECK-pending (ACHKP) restrictive status is set on when at least one base table LOB column error is detected and not invalidated as a result of running CHECK DATA AUXERROR REPORT. A base table space with the NOT LOGGED attribute and its LOB table spaces, which also have the NOT LOGGED attribute, are recovered to the current point in time in the same RECOVER utility invocation. The base table space is put in the auxiliary CHECK-pending state.

An XML table space is set to auxiliary CHECK-pending when CHECK DATA is run with the XMLERROR REPORT option, and CHECK DATA finds an error in an XML table space, the corresponding base table space, or an index space for the node ID.

Refer to the following table for information about resetting the auxiliary CHECK-pending status. This table lists the status name, abbreviation, affected object, and any corrective actions.

Table 151. Resetting auxiliary CHECK-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
Auxiliary CHECK-pending	ACHKP	Base table space	1. Update or delete invalid LOBs and XML objects using SQL. 2. Run the CHECK DATA utility with the appropriate SCOPE option to verify the validity of LOBs and XML objects and reset ACHKP status. You can use the REPAIR utility, followed by CHECK DATA, to reset the ACHKP status, but use caution.	1

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Table 151. Resetting auxiliary CHECK-pending status (continued)

Status	Abbreviation	Object affected	Corrective action	Notes

Note:

1. A base table space in the ACHKP status is unavailable for processing by SQL.

Auxiliary warning status

A base table space or LOB table space in the auxiliary warning status remains available for processing by SQL.

The auxiliary warning (AUXW) status is set when at least one base table LOB column has an invalidated LOB as a result of running CHECK DATA AUXERROR INVALIDATE. An attempt to retrieve an invalidated LOB results in a -904 SQL return code.

A base table space with the NOT LOGGED attribute and its LOB table spaces, which also have the NOT LOGGED attribute, are recovered to the current point in time in the same RECOVER utility invocation. The LOB table spaces are put in the auxiliary warning state if there were updates to the LOB table spaces after the recoverable point.

The RECOVER utility also sets AUXW status if it finds an invalid LOB column. Invalid LOB columns might result from a situation in which all the following actions occur:

1. LOB table space was defined with LOG NO.
2. LOB table space was recovered.
3. LOB was updated since the last image copy.

Refer to the following table for information about resetting the auxiliary warning status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 152. Resetting auxiliary warning status

Status	Abbreviation	Object affected	Corrective action	Notes
Auxiliary warning	AUXW	Base table space	1. Update or delete invalid LOBs and XML objects using SQL. 2. If an orphan LOB exists or a version mismatch exists between the base table and the auxiliary index, use REPAIR to delete the LOB from the LOB table space. 3. Run CHECK DATA utility to verify the validity of LOBs and XML objects and reset AUXW status.	1,2,3
Auxiliary warning	AUXW	LOB table space	1. Update or delete invalid LOBs and XML objects using SQL. 2. If an orphan LOB exists or a version mismatch exists between the base table and the auxiliary index, use REPAIR to delete the LOB from the LOB table space. 3. Run CHECK LOB utility to verify the validity of LOBs and XML objects and reset AUXW status.	1

Table 152. Resetting auxiliary warning status (continued)

Status	Abbreviation	Object affected	Corrective action	Notes

Note:

1. A base table space or LOB table space in the AUXW status is available for processing by SQL, even though it contains invalid LOBs. However, an attempt to retrieve an invalid LOB results in a -904 SQL return code.
2. DB2 can access all rows of a base table space that are in the AUXW status. SQL can update the invalid LOB column and delete base table rows, but the value of the LOB column cannot be retrieved. If DB2 attempts to access an invalid LOB column, a -904 SQL code is returned. The AUXW status remains on the base table space even when SQL deletes or updates the last invalid LOB column.
3. If CHECK DATA AUXERROR REPORT encounters only invalid LOB columns and no other LOB column errors, the base table space is set to the auxiliary warning status.

CHECK-pending status

The CHECK-pending (CHKP) restrictive status indicates that an object might be in an inconsistent state and must be checked.

The following utilities set CHECK-pending status on a table space if referential integrity constraints are encountered:

- LOAD with ENFORCE NO
- RECOVER to a point in time
- CHECK LOB

Table check violations place a table space or partition in CHECK-pending status when any of the following conditions exist:

- A check constraint is defined on a populated table by using the ALTER TABLE statement, and the value of the CURRENT RULES special register is DB2.
- The LOAD utility is run with CONSTRAINTS NO, and check constraints are defined on the table.
- CHECK DATA is run on a table that contains violations of check constraints.
- A point-in-time RECOVER introduces violations of check constraints.

An index might be placed in CHECK-pending status if you recovered an index to a specific RBA or LRSN from a copy and applied the log records, but you did not recover the table space in the same list. The CHECK-pending status can also be set on an index if you specified the table space and the index, but the recovery point in time was not a point of consistency (QUIESCE or COPY SHRLEVEL REFERENCE).

The CHECK-pending status can also affect a base table space or a LOB table space. CHECK-pending status for an XML table space is set only if a new XML schema for an XML type modifier was added or removed.

DB2 ignores informational referential integrity constraints and does not set CHECK-pending status for them.

The following table lists the actions to take to reset the CHECK-pending status.

Table 153. Resetting CHECK-pending status

Status	Abbreviation	Object affected	Corrective action
CHECK-pending	CHKP	Table space, base table space	Run the CHECK DATA utility. If a table space is in both REORG-pending and CHECK-pending status (or auxiliary CHECK-pending status), run the REORG TABLESPACE utility first and then run CHECK DATA to reset the respective states.
CHECK-pending	CHKP	Partitioning index, nonpartitioning index, index, XML index on the auxiliary table	1. Run the CHECK INDEX utility on the index. 2. If any errors are found, use the REBUILD INDEX utility to rebuild the index from existing data.
CHECK-pending	CHKP	LOB table space	Run the CHECK LOB utility to check the LOB table space. If any errors are found, take the following actions: 1. Correct any defects that are found in the LOB table space by using the REPAIR utility. 2. Run CHECK LOB again to reset the CHECK-pending status. 3. If the table space is in auxiliary warning (AUXW) status, take the actions in "Auxiliary warning status" on page 1104.
CHECK-pending	CHKP	XML table space	Run CHECK DATA to check the XML table space. If any errors are found, take the following actions: 1. Correct any defects that are found in the XML table space by using the REPAIR utility. 2. Run CHECK DATA again to reset the CHECK-pending status.

Related reference:

"Auxiliary CHECK-pending status" on page 1103
Chapter 12, "CHECK DATA," on page 79
Chapter 13, "CHECK INDEX," on page 109
Chapter 14, "CHECK LOB," on page 127
Chapter 29, "REORG TABLESPACE," on page 551
Chapter 26, "REBUILD INDEX," on page 427
Chapter 30, "REPAIR," on page 663

COPY-pending status

The COPY-pending (COPY) restrictive status indicates that the affected object must be copied.

DB2 ignores informational referential integrity constraints and does not set CHECK-pending status for them.

Refer to the following table for information about resetting the COPY-pending status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 154. Resetting COPY-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
COPY-pending	COPY	Table space, table space partition	Take an image copy of the affected object.	

DBETE status

An object is a table space, table space partition, index space, index partition, or logical index partition. The DBETE status identifies the objects that need special attention by the user.

To reduce outages caused by certain DBET abends or page set access error abends during restart or RESTORE SYSTEM, DB2 tolerates such abends and puts objects into advisory status DBETE, as well as a restrictive exception status that requires objects to be recovered. Depending on the type of object, either a table space or an index space, the restrictive exception status can be RECP, RBDP, or PSRBD.

Refer to the following table for information about resetting the error status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 155. Resetting OBJECT error status

Status	Abbreviation	Object affected	Corrective action	Notes
OBJECT error	DBETE	Table space, table space partition, index space, index partition, or logical index partition	Issue -DISPLAY command to see the status of the object. If the object is in DBETE along with restrictive states such as RECP, RBDP, PSRBD, use one of the following utilities to recover or rebuild the object: • RECOVER utility • LOAD utility with the REPLACE option • REBUILD utility The DBETE status is reset when RECP, RBDP, or PSRBD status is reset by the utility. If a table space or index space that contains partitions has a status of DBETE and RECP and is also listed as being of type UN (unknown type), you can still use the utilities in the preceding list to recover or rebuild the entire space. DBETE, RECP, RBDP, and PSRBD status can also be reset by issuing the following command, -START DB(db name) SP(space name) ACCESS(FORCE). Contact IBM Software Support to report the problem. DB2 log records need to be analyzed to diagnose the cause of the problem and determine further actions.	

Group buffer pool RECOVER-pending status

The group buffer pool RECOVER-pending (GRECP) status is set on when a coupling facility fails with pages that were not externalized. The affected object must be recovered.

Refer to the following table for information about resetting the group buffer pool RECOVER-pending status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 156. Resetting group buffer pool RECOVER-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
Group buffer pool RECOVER-pending	GRECP	Object	Recover the object, or use START DATABASE to recover the object.	

Tip: To avoid issuing -START DATABASE for every member, wait until a DSNI049I message is issued from each restarting member, then issue -START DATABASE to recover objects with GRECP-pending status. Any objects that are not defined with group buffer pool AUTOREC(YES) recovery need to be explicitly recovered.

Informational COPY-pending status

The informational COPY-pending (ICOPY) advisory status indicates that the affected object should be copied.

Refer to the following table for information about resetting the informational COPY-pending status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 157. Resetting informational COPY-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
Informational COPY-pending	ICOPY	NOT LOGGED table spaces	Copy the affected table space.	
Informational COPY-pending	ICOPY	Partitioning index, nonpartitioning index, index on the auxiliary table	Copy the affected index.	

PRO restricted status

The Persistent Read Only (PRO) restricted status indicates that read access by SQL or utilities is allowed, but all updates to the table space partition are prohibited.

SQL updates or utilities that attempt to update a table space partition that is in PRO restricted status receive a resource unavailable error. When one or more table space partitions are in PRO restricted status, run utilities that update data at the partition level.

PRO restricted status is turned on to prohibit all updates by the system administrator or database administrator, or by a product that runs with DB2 for

z/OS. The REPAIR SET utility sets the PRO restricted status. Do not turn off PRO restricted status without the consent of the system administrator or database administrator because updates to the partition might cause data loss.

Table 158. Resetting PRO restricted status

Status	Abbreviation	Object affected	Corrective action	Notes
Persistent Read Only	PRO	Table space partition	None	1, 2

Note:

1. MODIFY RECOVERY TABLESPACE DSNUM(n) forces the retention of the last two full image copies.
2. COPY TABLESPACE DSNUM(n) does not create a new full image copy of the partition.

REBUILD-pending status

A REBUILD-pending restrictive status indicates that the affected index or index partition is broken and must be rebuilt from the data.

REBUILD-pending (RBDP) status indicates that the physical or logical partition is inaccessible and must be rebuilt. RBDP status is set on a data-partitioned secondary index if you create the index after performing the following actions:

- Create a partitioned table space.
- Create a partitioning index.
- Insert a row into a table.

In this situation, the last partition of the table space is set to REORG-pending (REORP) restrictive status.

REBUILD-pending star (RBDP*) status indicates that a logical partition of a nonpartitioned secondary index is unavailable for read-write access and the entire index is unavailable for read access.

Page set REBUILD-pending (PSRBD) status indicates that an entire nonpartitioned secondary index or index on the auxiliary table is unavailable for read-write access.

Rebuilding an index and thereby resetting the REBUILD-pending status invalidates the dynamic statement cache for the related table.

If you alter the data type of a column to a numeric data type, RECOVER INDEX cannot complete. You must rebuild the index.

Refer to the following table for information about resetting a REBUILD-pending status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 159. Resetting REBUILD-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
REBUILD-pending	RBDP	Physical or logical index partition	Run the REBUILD utility on the affected index partition.	
REBUILD-pending star	RBDP*	Logical partitions of nonpartitioned secondary indexes	Run REBUILD INDEX PART or RECOVER utility on the affected logical partitions.	

Table 159. Resetting REBUILD-pending status (continued)

Status	Abbreviation	Object affected	Corrective action	Notes
Page set REBUILD-pending	PSRBD	Nonpartitioned secondary index, index on the auxiliary table	Run REBUILD INDEX ALL, the RECOVER utility, or run REBUILD INDEX listing all indexes in the affected index space.	
REBUILD-pending	RBDP, RBDP*, or PSRBD	all	The following actions also reset the REBUILD-pending status: • Use LOAD REPLACE for the table space or partition. • Use REPAIR SET INDEX with NORBDPEND on the index partition. Be aware that this does not correct the data inconsistency in the index partition. Use CHECK INDEX instead of REPAIR to verify referential integrity constraints. • Start the database that contains the index space with ACCESS FORCE. Be aware that this does not correct the data inconsistency in the index partition. • Run REORG INDEX SORTDATA on the affected index.	

RECOVER-pending status

The RECOVER-pending (RECP) restrictive status indicates that a table space or table space partition is broken and must be recovered.

Refer to the following table for information about resetting the RECOVER-pending status. This table lists the status name, abbreviation, affected objects, and any corrective actions.

Table 160. Resetting RECOVER-pending status

Status	Abbreviation	Object affected	Corrective action	Notes
RECOVER-pending	RECP	Table space	Run the RECOVER utility on the affected object.	
RECOVER-pending	RECP	Table space partition	Recover the partition.	
RECOVER-pending	RECP	Index on the auxiliary table	Correct the RECOVER-pending status by using one of the following utilities: • REBUILD INDEX • RECOVER INDEX • REORG INDEX SORTDATA	
RECOVER-pending	RECP	Index space	Run one of the following utilities on the affected index space to reset RECP, RBDP, RBDP*, or PSRBDP status: • REBUILD INDEX • RECOVER INDEX • REORG INDEX SORTDATA	

Table 160. Resetting RECOVER-pending status (continued)

Status	Abbreviation	Object affected	Corrective action	Notes
RECOVER-pending	RECP	Any	The following actions also reset the RECOVER-pending status: • Use LOAD REPLACE for the table space or partition. • Use REPAIR SET TABLESPACE or INDEX with NORCVRPEND on the table space or partition. Be aware that this does not correct the data inconsistency in the table space or partition. • Start the database that contains the table space or index space with ACCESS FORCE. Be aware that this does not correct the data inconsistency in the table space or partition.	

REFRESH-pending status

When DB2 marks an object in refresh-pending (REFP) status, it also puts the object in RECOVER-pending (RECP) or REBUILD-pending (RBDP or PSRBD) status.

For a table space, run LOAD REPLACE or the RECOVER utility to resolve this restricted status, or use the REBUILD INDEX utility to rebuild the index from the data.

Related reference:

"RECOVER-pending status" on page 1110

"REBUILD-pending status" on page 1109

"Syntax and options of the LOAD control statement" on page 247

Chapter 27, "RECOVER," on page 457

Chapter 26, "REBUILD INDEX," on page 427

REORG-pending status

The following three REORG-pending states indicate that an object either must or should be reorganized:

REORG-pending (REORP) restrictive status
Indicates that the object must be reorganized to apply definition changes before the data is accessible. REORP status must be reset for all adjacent logical partitions that are in REORP status.

REORG-pending (AREO*) advisory status
Indicates that the object needs to be reorganized for optimal performance. AREO* status can be reset on a single partition, regardless of whether adjacent partitions are also in AREO* status. The affected objects are not restricted and can be accessed by both readers and writers.

REORG-pending (AREOR) advisory status:
Indicates that the object should be reorganized to apply pending definition changes. AREOR status must be reset for all adjacent logical partitions that are in AREOR status. The affected objects are not restricted and can be accessed by both readers and writers. The affected objects are not modified until the REORG job that materializes the definition changes is run.

The following table lists the actions to take to reset one of these REORG-pending states.

Table 161. Resetting REORG-pending status

Status	Abbreviation	Object affected	Corrective action
REORG-pending	REORP	Table space or partition	Run one of the following utilities on the table space or one or more partitions: • REORG TABLESPACE • LOAD with the REPLACE option If a table space is in both REORG-pending and CHECK-pending status (or auxiliary CHECK-pending status), run REORG first and then run the CHECK DATA utility to clear the respective states. If one or more partitions are in REORP status, you must include all adjacent logical partitions that are in REORP status in the same REORG or LOAD job. For example, suppose that a partitioned table space has logical partitions in the following states: **P1** REORP **P2** REORP **P3** RW **P4** REORP **P5** REORP In this case, the partition range P1:P2 must be in the same utility job, and the partition range P4:P5 must be in the same utility job. You can either include both of these ranges in one utility job or run two separate jobs, one for each range. Alternatively, you can specify the SCOPE PENDING option so that REORG includes both ranges in REORP status.
Advisory REORG-pending	AREO*	Table space or partition	Run one of the following utilities on the table space or one or more partitions: • REORG TABLESPACE • LOAD with the REPLACE option If one or more partitions are in AREO* status, you can reset AREO* for a specific partition without being restricted by another AREO* status for an adjacent partition. AREO* status does not have to be reset for all affected partitions at the same time.

Table 161. Resetting REORG-pending status (continued)

Status	Abbreviation	Object affected	Corrective action
Advisory REORG-pending	AREO*	Index space or partition	Run one of the following utilities on the index space or one or more partitions: • REORG TABLESPACE • LOAD with the REPLACE option • REORG INDEX • REBUILD INDEX If one or more partitions are in AREO* status, you can reset AREO* for a specific partition without being restricted by another AREO* status for an adjacent partition. AREO* status does not have to be reset for all affected partitions at the same time.
Advisory REORG-pending	AREOR	Table space or partition	Run REORG TABLESPACE on the table space or all affected partitions. When AREOR is set at the partition level, you must include all adjacent logical partitions that are in REORP status in the same REORG job. For example, suppose that you change partition limits or change the page size and as a result, the table space has partitions in the following states: **P1** AREOR **P2** AREOR **P3** RW **P4** AREOR **P5** AREOR In this case, the partition range P1:P2 must be in the same REORG job, and the partition range P4:P5 must be in the same REORG job. You can either include both of these ranges in one REORG job or run two separate jobs, one for each range. Alternatively, you can specify the SCOPE PENDING option so that REORG includes both ranges in AREOR status. (You can run REORG on the individual partitions and not the entire adjacent range in AREOR. However, in that case, REORG does not materialize any pending definition changes and the AREOR status is not reset.) If you want to drop any pending definition changes, use the ALTER TABLESPACE statement with the DROP PENDING CHANGES clause. This statement removes the pending changes and resets the AREOR status.

Table 161. Resetting REORG-pending status (continued)

Status	Abbreviation	Object affected	Corrective action
Advisory REORG-pending	AREOR	Index space or partition	Run one of the following utilities on the index space or all affected partitions: • REORG TABLESPACE • REORG INDEX When AREOR is set at the partition level, you must include all adjacent logical partitions that are in REORP status in the same REORG job. See the example in the preceding row for table spaces. (You can run REORG on the individual partitions and not the entire adjacent range in AREOR. However, in that case, REORG does not materialize any pending definition changes and the AREOR status is not reset.)

Related reference:

ALTER TABLESPACE (DB2 SQL)

Chapter 29, “REORG TABLESPACE,” on page 551

Chapter 28, “REORG INDEX,” on page 513

Chapter 30, “REPAIR,” on page 663

Chapter 20, “LOAD,” on page 245

Restart-pending status

If an object has backout work pending at the end of DB2 restart, the object is placed in restart-pending (RESTP) status.

You cannot use LOAD REPLACE on an object that is in the RESTP status.

Utility activity against page sets or partitions with RESTP status is not allowed. Any attempt to access a page set or partition with RESTP status terminates with return code 8.

The following table explains how to reset the restart-pending status.

Table 162. Resetting restart-pending status

Status	Abbreviation	Object affected	Corrective action
Restart-pending	RESTP	Table space, table space partitions, index spaces, and physical index space partitions	Backout activity against the object must be completed. Either use the RECOVER POSTPONED command or restart the DB2 subsystem with the subsystem parameter LBACKOUT set to AUTO. Objects in the RESTP status remain unavailable until backout work is complete, or until restart is canceled and a conditional restart or cold start is performed in its place. Delay running REORG TABLESPACE SHRLEVEL CHANGE until all RESTP statuses are reset.

Related tasks:

Starting a table space or index space that has restrictions (DB2 Administration Guide)

Related reference:

LIMIT BACKOUT field (LBACKOUT subsystem parameter) (DB2 Installation and Migration)

-RECOVER POSTPONED (DB2) (DB2 Commands)

Appendix D. Productivity-aid sample programs

DB2 provides four sample programs that many users find helpful as productivity aids. These programs are shipped as source code so that you can modify them to meet your needs.

DSNTIAUL
The sample unload program. This program, which is written in assembler language, is a simple alternative to the UNLOAD utility. It unloads some or all rows from up to 100 DB2 tables. With DSNTIAUL, you can unload data of any DB2 built-in data type or distinct type. DSNTIAUL unloads the rows in a form that is compatible with the LOAD utility and generates utility control statements for LOAD. DSNTIAUL also lets you execute any SQL non-SELECT statement that can be executed dynamically..

DSNTIAD
A sample dynamic SQL program that is written in assembler language. With this program, you can execute any SQL statement that can be executed dynamically, except a SELECT statement.

DSNTEP2
A sample dynamic SQL program that is written in the PL/I language. With this program, you can execute any SQL statement that can be executed dynamically. You can use the source version of DSNTEP2 and modify it to meet your needs, or, if you do not have a PL/I compiler at your installation, you can use the object code version of DSNTEP2.

DSNTEP4
A sample dynamic SQL program that is written in the PL/I language. This program is identical to DSNTEP2 except DSNTEP4 uses multi-row fetch for increased performance. You can use the source version of DSNTEP4 and modify it to meet your needs, or, if you do not have a PL/I compiler at your installation, you can use the object code version of DSNTEP4.

Because these four programs also accept the static SQL statements CONNECT, SET CONNECTION, and RELEASE, you can use the programs to access DB2 tables at remote locations.

Retrieval of UTF-16 Unicode data: You can use DSNTEP2, DSNTEP4, and DSNTIAUL to retrieve Unicode UTF-16 graphic data. However, these programs might not be able to display some characters, if those characters have no mapping in the target SBCS EBCDIC CCSID.

DSNTIAUL and DSNTIAD are shipped only as source code, so you must precompile, assemble, link, and bind them before you can use them. If you want to use the source code version of DSNTEP2 or DSNTEP4, you must precompile, compile, link, and bind it. You need to bind the object code version of DSNTEP2 or DSNTEP4 before you can use it. Usually a system administrator prepares the programs as part of the installation process. The following table indicates which installation job prepares each sample program. All installation jobs are in data set DSNB10.SDSNSAMP.

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Table 163. Jobs that prepare DSNTIAUL, DSNTIAD, DSNTEP2, and DSNTEP4

Program name	Program preparation job
DSNTIAUL	DSNTEJ2A
DSNTIAD	DSNTIJTM
DSNTEP2 (source)	DSNTEJ1P
DSNTEP2 (object)	DSNTEJ1L
DSNTEP4 (source)	DSNTEJ1P
DSNTEP4 (object)	DSNTEJ1L

To run the sample programs, use the DSN RUN command.

The following table lists the load module name and plan name that you must specify, and the parameters that you can specify when you run each program.

Table 164. DSN RUN option values for DSNTIAUL, DSNTIAD, DSNTEP2, and DSNTEP4

Program name	Load module	Plan	Parameters
DSNTIAUL	DSNTIAUL	DSNTIBB1	SQL *number of rows per fetch* TOLWARN(NO | YES)
DSNTIAD	DSNTIAD	DSNTIAB1	RC0 SQLTERM(*termchar*)
DSNTEP2	DSNTEP2	DSNTEPB1	ALIGN(MID) or ALIGN(LHS) NOMIXED or MIXED SQLTERM(*termchar*) TOLWARN(NO | YES) PREPWARN
DSNTEP4	DSNTEP4	DSNTP491	ALIGN(MID) or ALIGN(LHS) NOMIXED or MIXED SQLTERM(*termchar*) TOLWARN(NO | YES) PREPWARN

Related reference:

RUN (DSN) (DB2 Commands)

DSNTIAUL

Use the DSNTIAUL program to unload data from DB2 tables into sequential data sets. The data is copied to the data sets and is not deleted from the table.

When multi-row fetch is used, parallelism might be disabled in the last parallel group in the top-level query block for a query. For very simple queries, parallelism might be disabled for the entire query when multi-row fetch is used. To obtain full parallelism when running DSNTIAUL, switch DSNTIAUL to single-row fetch mode by specifying 1 for the number of rows per fetch parameter.

DSNTIAUL uses SQL to access DB2. Operations on a row-level or column-level access control enforced table are subject to the rules specified for the access control. If the table is row-level access control enforced, DSNTIAUL receives and returns only the rows of the table that satisfy the row permissions for the user. If the table

is column-level access control enforced, DSNTIAUL receives and returns the values in the column values as modified by the column masks for the user.

DSNTIAUL parameters:

SQL
Specify SQL to indicate that your input data set contains one or more complete SQL statements, each of which ends with a semicolon. You can include any SQL statement that can be executed dynamically in your input data set. In addition, you can include the static SQL statements CONNECT, SET CONNECTION, or RELEASE. Static SQL statements must be uppercase.

DSNTIAUL uses the SELECT statements to determine which tables to unload and dynamically executes all other statements except CONNECT, SET CONNECTION, and RELEASE. DSNTIAUL executes CONNECT, SET CONNECTION, and RELEASE statically to connect to remote locations.

number of rows per fetch
Specify a number from 1 to 32767 to specify the number of rows per fetch that DSNTIAUL retrieves. If you do not specify this number, DSNTIAUL retrieves 100 rows per fetch. This parameter can be specified with the SQL parameter.

TOLWARN
Specify NO (the default) or YES to indicate whether DSNTIAUL continues to retrieve rows after receiving an SQL warning:

(NO) If a warning occurs when DSNTIAUL executes an OPEN or FETCH to retrieve rows, DSNTIAUL stops retrieving rows. If the SQLWARN1, SQLWARN2, SQLWARN6, or SQLWARN7 flag is set when DSNTIAUL executes a FETCH to retrieve rows, DSNTIAUL continues to retrieve rows.

(YES) If a warning occurs when DSNTIAUL executes an OPEN or FETCH to retrieve rows, DSNTIAUL continues to retrieve rows.

LOBFILE(*prefix***)**
Specify LOBFILE to indicate that you want DSNTIAUL to dynamically allocate data sets, each to receive the full content of a LOB cell. (A LOB cell is the intersection of a row and a LOB column.) If you do not specify the LOBFILE option, you can unload up to only 32 KB of data from a LOB column.

prefix
Specify a high-level qualifier for these dynamically allocated data sets. You can specify up to 17 characters. The qualifier must conform with the rules for TSO data set names.

DSNTIAUL uses a naming convention for these dynamically allocated data sets of *prefix*.Qiiiiiii.Cjjjjjjj.Rkkkkkkk, where these qualifiers have the following values:

prefix
The high-level qualifier that you specify in the LOBFILE option.

Qiiiiiii
The sequence number (starting from 0) of a query that returns one or more LOB columns

Cjjjjjjj
The sequence number (starting from 0) of a column in a query that returns one or more LOB columns

Rkkkkkkk
The sequence number (starting from 0) of a row of a result set that has one or more LOB columns.

The generated LOAD statement contains LOB file reference variables that can be used to load data from these dynamically allocated data sets.

If you do not specify the SQL parameter, your input data set must contain one or more single-line statements (without a semicolon) that use the following syntax:

```
table or view name [WHERE conditions] [ORDER BY columns]
```

Each input statement must be a valid SQL SELECT statement with the clause SELECT * FROM omitted and with no ending semicolon. DSNTIAUL generates a SELECT statement for each input statement by appending your input line to SELECT * FROM, then uses the result to determine which tables to unload. For this input format, the text for each table specification can be a maximum of 72 bytes and must not span multiple lines.

You can use the input statements to specify SELECT statements that join two or more tables or select specific columns from a table. If you specify columns, you need to modify the LOAD statement that DSNTIAUL generates.

DSNTIAUL data sets:

Data set
Description

SYSIN
Input data set.

You cannot enter comments in DSNTIAUL input.

The record length for the input data set must be at least 72 bytes. DSNTIAUL reads only the first 72 bytes of each record.

SYSPRINT
Output data set. DSNTIAUL writes informational and error messages in this data set.

The record length for the SYSPRINT data set is 121 bytes.

SYSPUNCH
Output data set. DSNTIAUL writes the LOAD utility control statements in this data set.

SYSREC*nn*
Output data sets. The value *nn* ranges from 00 to 99. You can have a maximum of 100 output data sets for a single execution of DSNTIAUL. Each data set contains the data that is unloaded when DSNTIAUL processes a SELECT statement from the input data set. Therefore, the number of output data sets must match the number of SELECT statements (if you specify parameter SQL) or table specifications in your input data set.

Define all data sets as sequential data sets. You can specify the record length and block size of the SYSPUNCH and SYSREC*nn* data sets. The maximum record length for the SYSPUNCH and SYSREC*nn* data sets is 32760 bytes.

DSNTIAUL return codes:

Table 165. DSNTIAUL return codes

Return code	Meaning
0	Successful completion.
4	An SQL statement received a warning code. • If TOLWARN(YES) is specified, and the warning occurred on a FETCH or OPEN during the processing of a SELECT statement, DB2 performs the unload operation. • Otherwise if the SQL statement was a SELECT statement, DB2 did not perform the associated unload operation. If DB2 returns a +394, which indicates that it is using optimization hints, or a +395, which indicates one or more invalid optimization hints, DB2 performs the unload operation.
8	An SQL statement received an error code. If the SQL statement was a SELECT statement, DB2 did not perform the associated unload operation or did not complete it.
12	DSNTIAUL could not open a data set, an SQL statement returned a severe error code (-144, -302, -804, -805, -818, -902, -906, -911, -913, -922, -923, -924, or -927), or an error occurred in the SQL message formatting routine.

Example of using DSNTIAUL to unload a subset of rows in a table:

Suppose that you want to unload the rows for department D01 from the project table. Because you can fit the table specification on one line, and you do not want to execute any non-SELECT statements, you do not need the SQL parameter. Your invocation looks like the one that is shown in the following figure:

```
//UNLOAD  EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD  SYSOUT=*
//SYSTSIN  DD  *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTIAUL) PLAN(DSNTIBB1) -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSREC00 DD DSN=DSN8UNLD.SYSREC00,
//            UNIT=SYSDA,SPACE=(32760,(1000,500)),DISP=(,CATLG),
//            VOL=SER=SCR03
//SYSPUNCH DD DSN=DSN8UNLD.SYSPUNCH,
//            UNIT=SYSDA,SPACE=(800,(15,15)),DISP=(,CATLG),
//            VOL=SER=SCR03,RECFM=FB,LRECL=120,BLKSIZE=1200
//SYSIN    DD *DSN8B10
.PROJ WHERE DEPTNO='D01'
```

Example of using DSNTIAUL to unload rows in more than one table:

Suppose that you also want to use DSNTIAUL to perform the following actions:

- Unload all rows from the project table
- Unload only rows from the employee table for employees in departments with department numbers that begin with D, and order the unloaded rows by employee number
- Lock both tables in share mode before you unload them

- Retrieve 250 rows per fetch

For these activities, you must specify the SQL parameter and specify the number of rows per fetch when you run DSNTIAUL. Your DSNTIAUL invocation is shown in the following figure:

```
//UNLOAD  EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD  SYSOUT=*
//SYSTSIN  DD  *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTIAUL) PLAN(DSNTIBB1) PARMS('SQL,250') -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSREC00 DD DSN=DSN8UNLD.SYSREC00,
//            UNIT=SYSDA,SPACE=(32760,(1000,500)),DISP=(,CATLG),
//            VOL=SER=SCR03
//SYSREC01 DD DSN=DSN8UNLD.SYSREC01,
//            UNIT=SYSDA,SPACE=(32760,(1000,500)),DISP=(,CATLG),
//            VOL=SER=SCR03
//SYSPUNCH DD DSN=DSN8UNLD.SYSPUNCH,
//            UNIT=SYSDA,SPACE=(800,(15,15)),DISP=(,CATLG),
//            VOL=SER=SCR03,RECFM=FB,LRECL=120,BLKSIZE=1200
//SYSIN    DD *
LOCK TABLE DSN8B10.EMP IN SHARE MODE;
LOCK TABLE DSN8B10.PROJ IN SHARE MODE;
SELECT * FROM DSN8B10.PROJ;
SELECT * FROM DSN8B10.EMP
  WHERE WORKDEPT LIKE 'D%'
  ORDER BY EMPNO;
```

Example of using DSNTIAUL to obtain LOAD utility control statements:

If you want to obtain the LOAD utility control statements for loading rows into a table, but you do not want to unload the rows, you can set the data set names for the SYSREC*nn* data sets to DUMMY. For example, to obtain the utility control statements for loading rows into the department table, you invoke DSNTIAUL as shown in the following figure:

```
//UNLOAD  EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD  SYSOUT=*
//SYSTSIN  DD  *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTIAUL) PLAN(DSNTIBB1) -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSREC00 DD DUMMY
//SYSPUNCH DD DSN=DSN8UNLD.SYSPUNCH,
//            UNIT=SYSDA,SPACE=(800,(15,15)),DISP=(,CATLG),
//            VOL=SER=SCR03,RECFM=FB,LRECL=120,BLKSIZE=1200
//SYSIN    DD *DSN8B10
.DEPT
```

Example of using DSNTIAUL to unload LOB data:

This example uses the sample LOB table with the following structure:

```
CREATE TABLE DSN8910.EMP_PHOTO_RESUME
( EMPNO CHAR(06) NOT NULL,
EMP_ROWID ROWID NOT NULL GENERATED ALWAYS,
PSEG_PHOTO BLOB(500K),
BMP_PHOTO BLOB(100K),
```

```
RESUME CLOB(5K),
PRIMARY KEY (EMPNO))
IN DSN8D91L.DSN8S91B
CCSID EBCDIC;
```

The following call to DSNTIAUL unloads the sample LOB table. The parameters for DSNTIAUL indicate the following options:

- The input data set (SYSIN) contains SQL.
- DSNTIAUL is to retrieve 2 rows per fetch.
- DSNTIAUL places the LOB data in data sets with a high-level qualifier of DSN8UNLD.

```
//UNLOAD   EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD *
  DSN SYSTEM(DSN)
  RUN PROGRAM(DSNTIAUL) PLAN(DSNTIB91) -
  PARMS('SQL,2,LOBFILE(DSN8UNLD)') -
  LIB('DSN910.RUNLIB.LOAD')
//SYSPRINT  DD SYSOUT=*
//SYSUDUMP  DD SYSOUT=*
//SYSREC00  DD DSN=DSN8UNLD.SYSREC00,
//             UNIT=SYSDA,SPACE=(800,(15,15)),DISP=(,CATLG),
//             VOL=SER=SCR03,RECFM=FB
//SYSPUNCH  DD DSN=DSN8UNLD.SYSPUNCH,
//             UNIT=SYSDA,SPACE=(800,(15,15)),DISP=(,CATLG),
//             VOL=SER=SCR03,RECFM=FB
//SYSIN     DD *
  SELECT * FROM DSN8910.EMP_PHOTO_RESUME;
```

Given that the sample LOB table has 4 rows of data, DSNTIAUL produces the following output:

- Data for columns EMPNO and EMP_ROWID are placed in the data set that is allocated according to the SYSREC00 DD statement. The data set name is DSN8UNLD.SYSREC00
- A generated LOAD statement is placed in the data set that is allocated according to the SYSPUNCH DD statement. The data set name is DSN8UNLD.SYSPUNCH
- The following data sets are dynamically created to store LOB data:
  - DSN8UNLD.Q0000000.C0000002.R0000000
  - DSN8UNLD.Q0000000.C0000002.R0000001
  - DSN8UNLD.Q0000000.C0000002.R0000002
  - DSN8UNLD.Q0000000.C0000002.R0000003
  - DSN8UNLD.Q0000000.C0000003.R0000000
  - DSN8UNLD.Q0000000.C0000003.R0000001
  - DSN8UNLD.Q0000000.C0000003.R0000002
  - DSN8UNLD.Q0000000.C0000003.R0000003
  - DSN8UNLD.Q0000000.C0000004.R0000000
  - DSN8UNLD.Q0000000.C0000004.R0000001
  - DSN8UNLD.Q0000000.C0000004.R0000002
  - DSN8UNLD.Q0000000.C0000004.R0000003

  For example, DSN8UNLD.Q0000000.C0000004.R0000001 means that the data set contains data that is unloaded from the second row (R0000001) and the fifth column (C0000004) of the result set for the first query (Q0000000).

DSNTIAD

Use the DSNTIAD program to execute SQL statements other than SELECT statements dynamically.

DSNTIAD parameters:

RC0

If you specify this parameter, DSNTIAD ends with return code 0, even if the program encounters SQL errors. If you do not specify RC0, DSNTIAD ends with a return code that reflects the severity of the errors that occur. Without RC0, DSNTIAD terminates if more than 10 SQL errors occur during a single execution.

SQLTERM(*termchar*)

Specify this parameter to indicate the character that you use to end each SQL statement. You can use any special character **except** one of those listed in the following table. SQLTERM(;) is the default.

Table 166. Invalid special characters for the SQL terminator

Name	Character	Hexadecimal representation
blank		X'40'
comma	,	X'6B'
double quotation mark	"	X'7F'
left parenthesis	(	X'4D'
right parenthesis	)	X'5D'
single quotation mark	'	X'7D'
underscore	_	X'6D'

Use a character other than a semicolon if you plan to execute a statement that contains embedded semicolons.

example:

Suppose that you specify the parameter SQLTERM(#) to indicate that the character # is the statement terminator. Then a CREATE TRIGGER statement with embedded semicolons looks like this:

```
CREATE TRIGGER NEW_HIRE
  AFTER INSERT ON EMP
  FOR EACH ROW MODE DB2SQL
  BEGIN ATOMIC
    UPDATE COMPANY_STATS SET NBEMP = NBEMP + 1;
  END#
```

A CREATE PROCEDURE statement with embedded semicolons looks like the following statement:

```
CREATE PROCEDURE PROC1 (IN PARM1 INT, OUT SCODE INT)
  LANGUAGE SQL
  BEGIN
    DECLARE SQLCODE INT;
    DECLARE EXIT HANDLER FOR SQLEXCEPTION
      SET SCODE = SQLCODE;
    UPDATE TBL1 SET COL1 = PARM1;
  END #
```

Be careful to choose a character for the statement terminator that is not used within the statement.

DSNTIAD data sets:

Data set
Description

SYSIN
Input data set. In this data set, you can enter any number of non-SELECT SQL statements, each terminated with a semicolon. A statement can span multiple lines, but DSNTIAD reads only the first 72 bytes of each line.

You cannot enter comments in DSNTIAD input.

SYSPRINT
Output data set. DSNTIAD writes informational and error messages in this data set. DSNTIAD sets the record length of this data set to 121 bytes and the block size to 1210 bytes.

Define all data sets as sequential data sets.

DSNTIAD return codes:

Table 167. DSNTIAD return codes

Return code	Meaning
0	Successful completion, or the user-specified parameter RC0.
4	An SQL statement received a warning code.
8	An SQL statement received an error code.
12	DSNTIAD could not open a data set, the length of an SQL statement was more than 2 MB, an SQL statement returned a severe error code (-8*nn* or -9*nn*), or an error occurred in the SQL message formatting routine.

Example of DSNTIAD invocation:

Suppose that you want to execute 20 UPDATE statements, and you do not want DSNTIAD to terminate if more than 10 errors occur. Your invocation looks like the one that is shown in the following figure:

```
//RUNTIAD EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTIAD) PLAN(DSNTIAB1) PARMS('RC0') -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSIN    DD *
UPDATE DSN8B10.PROJ SET DEPTNO='J01' WHERE DEPTNO='A01';
UPDATE DSN8B10.PROJ SET DEPTNO='J02' WHERE DEPTNO='A02';
:
UPDATE DSN8B10.PROJ SET DEPTNO='J20' WHERE DEPTNO='A20';
```

DSNTEP2 and DSNTEP4

Use the DSNTEP2 or DSNTEP4 programs to execute SQL statements dynamically.

DSNTEP4 is identical to DSNTEP2 except that it uses multi-row fetch for increased performance. When multi-row fetch is used, parallelism might be disabled in the last parallel group in the top-level query block for a query. For very simple queries, parallelism might be disabled for the entire query when multi-row fetch is used. To obtain full parallelism, either use DSNTEP2 or specify the control option SET MULT_FETCH 1 for DSNTEP4.

DSNTEP2 and DSNTEP4 write their results to the data set that is defined by the SYSPRINT DD statement. SYSPRINT data must have a logical record length of 133 bytes (LRECL=133). Otherwise, the program issues return code 12 with abend U4038 and reason code 1. This abend occurs due to the PL/I file exception error IBM0201S ONCODE=81. The following error message is issued:

```
The UNDEFINEDFILE condition was raised because of conflicting DECLARE
and OPEN attributes (FILE= SYSPRINT).
```

If you use applications or other automation to process output from DSNTEP2 or DSNTEP4, be aware that minor changes in the format can occur as a result of service or enhancements. Such changes might require you to adjust your processes that use the output of these programs.

Important: When you allocate a new data set with the SYSPRINT DD statement, either specify a DCB with RECFM=FBA and LRECL=133, or do not specify the DCB parameter.

DSNTEP2 and DSNTEP4 parameters:

ALIGN(MID) or ALIGN(LHS)
Specifies the alignment.

ALIGN(MID)
Specifies that DSNTEP2 or DSNTEP4 output should be centered. **ALIGN(MID)** is the default.

ALIGN(LHS)
Specifies that the DSNTEP2 or DSNTEP4 output should be left-justified.

NOMIXED or MIXED
Specifies whether DSNTEP2 or DSNTEP4 contains any DBCS characters.

NOMIXED
Specifies that the DSNTEP2 or DSNTEP4 input contains no DBCS characters. **NOMIXED** is the default.

MIXED
Specifies that the DSNTEP2 or DSNTEP4 input contains some DBCS characters.

PREPWARN
Specifies that DSNTEP2 or DSNTEP4 is to display details about any SQL warnings that are encountered at PREPARE time.

Regardless of whether you specify PREPWARN, when an SQL warning is encountered at PREPARE time, the program displays the message `SQLWARNING ON PREPARE` and sets the return code to 4. If DSNTEP2 is bound with REOPT(ALWAYS), it is normal that an SQL warning is encountered before PREPARE and return code is set to 4 if incremental bind happens. When you specify PREPWARN, the program also displays the details about any SQL warnings.

SQLFORMAT

Specifies how DSNTEP2 or DSNTEP4 pre-processes SQL statements before passing them to DB2. Select one of the following options:

SQL This is the preferred mode for SQL statements other than SQL procedural language. When you use this option, which is the default, DSNTEP2 or DSNTEP4 collapses each line of an SQL statement into a single line before passing the statement to DB2. DSNTEP2 or DSNTEP4 also discards all SQL comments.

SQLCOMNT

This mode is suitable for all SQL, but it is intended primarily for SQL procedural language processing. When this option is in effect, behavior is similar to SQL mode, except that DSNTEP2 or DSNTEP4 does not discard SQL comments. Instead, it automatically terminates each SQL comment with a line feed character (hex 25), unless the comment is already terminated by one or more line formatting characters. Use this option to process SQL procedural language with minimal modification by DSNTEP2 or DSNTEP4.

SQLPL

This mode is suitable for all SQL, but it is intended primarily for SQL procedural language processing. When this option is in effect, DSNTEP2 or DSNTEP4 retains SQL comments and terminates each line of an SQL statement with a line feed character (hex 25) before passing the statement to DB2. Lines that end with a split token are not terminated with a line feed character. Use this mode to obtain improved diagnostics and debugging of SQL procedural language.

SQLTERM(*termchar*)

Specifies the character that you use to end each SQL statement. You can use any character except one of those that are listed in Table 166 on page 1124. **SQLTERM(;)** is the default.

Use a character other than a semicolon if you plan to execute a statement that contains embedded semicolons.

Example: Suppose that you specify the parameter SQLTERM(#) to indicate that the character # is the statement terminator. Then a CREATE TRIGGER statement with embedded semicolons looks like this:

```
CREATE TRIGGER NEW_HIRE
  AFTER INSERT ON EMP
  FOR EACH ROW MODE DB2SQL
  BEGIN ATOMIC
    UPDATE COMPANY_STATS SET NBEMP = NBEMP + 1;
  END#
```

A CREATE PROCEDURE statement with embedded semicolons looks like the following statement:

```
CREATE PROCEDURE PROC1 (IN PARM1 INT, OUT SCODE INT)
  LANGUAGE SQL
  BEGIN
    DECLARE SQLCODE INT;
    DECLARE EXIT HANDLER FOR SQLEXCEPTION
      SET SCODE = SQLCODE;
    UPDATE TBL1 SET COL1 = PARM1;
  END #
```

Be careful to choose a character for the statement terminator that is not used within the statement.

If you want to change the SQL terminator within a series of SQL statements, you can use the --#SET TERMINATOR control statement.

Example: Suppose that you have an existing set of SQL statements to which you want to add a CREATE TRIGGER statement that has embedded semicolons. You can use the default SQLTERM value, which is a semicolon, for all of the existing SQL statements. Before you execute the CREATE TRIGGER statement, include the --#SET TERMINATOR # control statement to change the SQL terminator to the character #:

```
SELECT * FROM DEPT;
SELECT * FROM ACT;
SELECT * FROM EMPPROJACT;
SELECT * FROM PROJ;
SELECT * FROM PROJACT;
--#SET TERMINATOR #
CREATE TRIGGER NEW_HIRE
  AFTER INSERT ON EMP
  FOR EACH ROW MODE DB2SQL
  BEGIN ATOMIC
    UPDATE COMPANY_STATS SET NBEMP = NBEMP + 1;
  END#
```

See the following discussion of the SYSIN data set for more information about the --#SET control statement.

TOLWARN
Indicates whether DSNTEP2 or DSNTEP4 continues to process SQL SELECT statements after receiving an SQL warning. You can specify one of the following values:

NO Indicates that the program stops processing the SELECT statement if a warning occurs when the program executes an OPEN or FETCH for a SELECT statement. NO is the default value for TOLWARN.

The following exceptions exist:

- If SQLCODE +445 or SQLCODE +595 occurs when DSNTEP2 or DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement.
- If SQLCODE +354 occurs when DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement.
- If SQLCODE +802 occurs when DSNTEP2 or DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement if the TOLARTHWRN control statement is set to YES.

YES
Indicates that the program continues to process the SELECT statement if a warning occurs when the program executes an OPEN or FETCH for a SELECT statement.

DSNTEP2 and DSNTEP4 data sets:

The following data sets are used by DSNTEP2 and DSNTEP4:

SYSIN
Input data set. In this data set, you can enter any number of SQL statements, each terminated with a semicolon. A statement can span multiple lines, but DSNTEP2 or DSNTEP4 reads only the first 72 bytes of each line. You must explicitly commit any SQL statements except the last one.

You can enter comments in DSNTEP2 or DSNTEP4 input with an asterisk (*) in column 1 or two hyphens (--) anywhere on a line. Text that follows the asterisk is considered to be comment text. Text that follows two hyphens can be comment text or a control statement.Comments are not considered in dynamic statement caching. Comments and control statements cannot span lines.

You can enter control statements of the following form in the DSNTEP2 and DSNTEP4 input data set:

```
--#SET control-option value
```

You can specify the following control options. If you specify a value of NO for any of the options in this list, the program behaves as if you did not specify the parameter.

TERMINATOR
The SQL statement terminator. *value* is any single-byte character other than one of those that are listed in Table 166 on page 1124. The default is the value of the SQLTERM parameter.

ROWS_FETCH
The number of rows that are to be fetched from the result table. *value* is a numeric literal between -1 and the number of rows in the result table. -1 means that all rows are to be fetched. The default is -1.

ROWS_OUT
The number of fetched rows that are to be sent to the output data set. *value* is a numeric literal between -1 and the number of fetched rows. -1 means that all fetched rows are to be sent to the output data set. The default is -1.

MULT_FETCH
This option is valid only for DSNTEP4. Use MULT_FETCH to specify the number of rows that are to be fetched at one time from the result table. The default fetch amount for DSNTEP4 is 100 rows, but you can specify from 1 to 32676 rows.

TOLWARN
Indicates whether DSNTEP2 or DSNTEP4 continues to process SQL SELECT statements after receiving an SQL warning. You can specify one of the following values:

NO Indicates that the program stops processing the SELECT statement if a warning occurs when the program executes an OPEN or FETCH for a SELECT statement. NO is the default value for TOLWARN.

The following exceptions exist:

- If SQLCODE +445 or SQLCODE +595 occurs when DSNTEP2 or DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement.
- If SQLCODE +354 occurs when DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement.
- If SQLCODE +802 occurs when DSNTEP2 or DSNTEP4 executes a FETCH for a SELECT statement, the program continues to process the SELECT statement if the TOLARTHWRN control statement is set to YES.

YES
Indicates that the program continues to process the SELECT statement if a warning occurs when the program executes an OPEN or FETCH for a SELECT statement.

TOLARTHWRN
Indicates whether DSNTEP2 and DSNTEP4 continue to process an SQL SELECT statement after an arithmetic SQL warning (SQLCODE +802) is returned. *value* is either NO (the default) or YES.

PREPWARN
Specifies that DSNTEP2 or DSNTEP4 is to display details about any SQL warnings that are encountered at PREPARE time.

Regardless of whether you specify PREPWARN, when an SQL warning is encountered at PREPARE time, the program displays the message `SQLWARNING ON PREPARE` and sets the return code to 4. If DSNTEP2 is bound with REOPT(ALWAYS), it is normal that an SQL warning is encountered before PREPARE and return code is set to 4 if incremental bind happens. When you specify PREPWARN, the program also displays the details about any SQL warnings.

SQLFORMAT
Specifies how DSNTEP2 or DSNTEP4 pre-processes SQL statements before passing them to DB2. Select one of the following options:

SQL This is the preferred mode for SQL statements other than SQL procedural language. When you use this option, which is the default, DSNTEP2 or DSNTEP4 collapses each line of an SQL statement into a single line before passing the statement to DB2. DSNTEP2 or DSNTEP4 also discards all SQL comments.

SQLCOMNT
This mode is suitable for all SQL, but it is intended primarily for SQL procedural language processing. When this option is in effect, behavior is similar to SQL mode, except that DSNTEP2 or DSNTEP4 does not discard SQL comments. Instead, it automatically terminates each SQL comment with a line feed character (hex 25), unless the comment is already terminated by one or more line formatting characters. Use this option to process SQL procedural language with minimal modification by DSNTEP2 or DSNTEP4.

SQLPL
This mode is suitable for all SQL, but it is intended primarily for SQL procedural language processing. When this option is in effect, DSNTEP2 or DSNTEP4 retains SQL comments and terminates each line of an SQL statement with a line feed character (hex 25) before passing the statement to DB2. Lines that end with a split token are not terminated with a line feed character. Use this mode to obtain improved diagnostics and debugging of SQL procedural language.

MAXERRORS
Specifies that number of errors that DSNTEP2 and DSNTEP4 handle before processing stops. The default is 10.

SYSPRINT
Output data set. DSNTEP2 and DSNTEP4 write informational and error messages in this data set. DSNTEP2 and DSNTEP4 write output records of no more than 133 bytes.

Define all data sets as sequential data sets.

DSNTEP2 and DSNTEP4 return codes

Table 168. DSNTEP2 and DSNTEP4 return codes

Return code	Meaning
0	Successful completion.
4	An SQL statement received a warning code.
8	An SQL statement received an error code.
12	The length of an SQL statement was more than 32760 bytes, an SQL statement returned a severe error code (-8*nn* or -9*nn*), or an error occurred in the SQL message formatting routine.

Example of DSNTEP2 invocation

Suppose that you want to use DSNTEP2 to execute SQL SELECT statements that might contain DBCS characters. You also want left-aligned output. Your invocation looks like the one in the following figure.

```
//RUNTEP2 EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTEP2) PLAN(DSNTEPB1) PARMS('/ALIGN(LHS) MIXED TOLWARN(YES)') -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSIN    DD *
SELECT * FROM DSN8B10.PROJ;
```

Example of DSNTEP4 invocation

Suppose that you want to use DSNTEP4 to execute SQL SELECT statements that might contain DBCS characters, and you want center-aligned output. You also want DSNTEP4 to fetch 250 rows at a time. Your invocation looks like the one in the following figure:

```
//RUNTEP2 EXEC PGM=IKJEFT01,DYNAMNBR=20
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
 DSN SYSTEM(DSN)
 RUN  PROGRAM(DSNTEP4) PLAN(DSNTEPB1) PARMS('/ALIGN(MID) MIXED') -
       LIB('DSNB10.RUNLIB.LOAD')
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSIN    DD *
--#SET MULT_FETCH 250
SELECT * FROM DSN8B10.EMP;
```

Appendix E. DSN1SMFP

The DSN1SMFP utility processes DB2 trace data into reports that are useful for evaluating and auditing the evaluated configuration.

PSPI DSN1SMFP accepts data that SMF collects in standard SMF format and produces from one to eighteen reports. DSN1SMFP accepts all SMF record types, but it processes only type 101 (DB2 Accounting) and 102 (DB2 Performance) records. DSN1SMFP checks each type 101 and 102 record for DB2 audit trace types of these DB2

- 003: Accounting - DDF Data by Location (security-relevant fields only)
- 004: Trace Start
- 005: Trace Stop
- 023: Utility Start
- 024: Utility Change
- 025: Utility End
- 083: Identify End
- 106: System Parameters (security-relevant fields only)
- 140: Audit Authorization Failures
- 141: Audit DDL Grant/Revoke
- 142: Audit DDL Create/Alter/Drop
- 143: Audit First Write
- 144: Audit First Read
- 145: Audit DML Statement
- 269: Trusted Connection
- 270: Trusted Context
- 350: SQL Statement
- 361: Audit Administrative Authorities
- 362: Trace Start and Stop with AUDITPOLICY.

IFCIDs: Each such trace type is extracted and outputted in report format to a dedicated DD for that trace type.

Important: At a minimum, ensure that the following traces are started when you collect SMF records for input to DSN1SMFP.

Table 169. Traces to start for DSN1SMFP

Trace type	Class	IFCID
Accounting	1	3
Accounting	1	106
Audit	1	140
Audit	2	141
Audit	3	142
Audit	4	143
Audit	5	144
Audit	6	145
Audit	7	83
Audit	8	23

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Table 169. Traces to start for DSN1SMFP (continued)

Trace type	Class	IFCID
Audit	8	24
Audit	8	25
Audit	10	269
Audit	10	270
Audit	11	361
Audit		362
Performance	30	350

IFCIDs 4 and 5 are started automatically when you start or stop any other trace, and IFCID 362 is started automatically when you start an audit policy trace.

DSN1SMFP also counts and reports the following values in the end-of-job summary:

- Total SMF records that are read
- Total SMF type 101 records
- Total SMF type 102 records
- Separate totals for IFCID 0003, 0004, 0005, 0023, 0024, 0025, 0083, 0106, 0140, 0141, 0142, 0143, 0144, 0145, 0269, 0270, 0350, 0361, 0362, and other IFCID records that are read
- Separate totals for formatted IFCID 0003, 0004, 0005, 0023, 0024, 0025, 0083, 0106, 0140, 0141, 0142, 0143, 0144, 0145, 0269, 0270, 0350, 0361, 0362 records that are written
- Total formatted records that are written

You can allocate each output DD of interest to a print device, data set, or held output.

DSN1SMFP loads the local (site-provided) DSNHDECP module to obtain the EBCDIC CCSID for conversion of Unicode-encoded strings. Users of DSN1SMFP must ensure that the library where the local DSNHDECP module resides (typically *prefix*.SDSNEXIT) is available and allocated ahead of *prefix*.SDSNLOAD in the JOBLIB or STEPLIB DD concatenation. When DSN1SMFP encounters an IFCID 0106, if the EBCDIC CCSID that is used by DB2 does not agree with the CCSID that is loaded from DSNHDECP, DSN1SMFP reports a warning message and ends with a minimum return code of 4. PSPI

The following topics provide additional information:

- "Before running DSN1SMFP"
- "Running DSN1SMFP" on page 1135
- "Sample DSN1SMFP control statement" on page 1135
- "DSN1SMFP output" on page 1136

Before running DSN1SMFP

You need to know the required environment, authorization, and control statement of the DSN1SMFP utility before you run it.

Environment

DSN1SMFP runs as a batch z/OS job. DB2 does not need to be started.

Required authorization

DSN1SMFP does not require authorization. However, if any of the SMF records are RACF-protected, the authorization ID of the job must have READ RACF authority.

Control statement

See "Sample DSN1SMFP control statement" for an example of using DSN1SMFP to extract, format, and print the SMF records.

Required input

You must specify both the SMF records and the local DSNHDECP load module:

SMFIN DD
Defines the SMF records to extract, format, and print.

DSNHDECP
The local DSNHDECP (data only) load module to use to obtain the EBCDIC CCSID for conversion of Unicode-encoded strings.

Running DSN1SMFP

About this task

PSPI Sample job DSNTEJCC provides the basic JCL framework that is needed to run DSN1SMFP. See the DSNTEJCC prolog for directions on how to customize it for use at your site.

Procedure

To run the DSN1SMFP utility:

Use the following EXEC statement:

```
//stepname EXEC PGM=DSN1SMFP
```

PSPI

Sample DSN1SMFP control statement

PSPI The following statements specify that DSN1SMFP is to extract, format, and print the SMF records that are specified in the SMFIN DD statement.

```
//DSN1SMFP EXEC PGM=DSN1SMFP,COND=(4,LT)
//STEPLIB   DD DISP=SHR,DSN=prefix.SDSNEXIT <- req'd for local DSNHDECP
//          DD DISP=SHR,DSN=prefix.SDSNLOAD
//SMFIN     DD DISP=SHR,DSN=SMF records with DB2 trace data
//SYSPRINT  DD SYSOUT=*                     <- messages and EOJ summary
//IFCID003  DD ...
//IFCID004  DD ...
//IFCID005  DD ...
//IFCID023  DD ...
//IFCID024  DD ...
//IFCID025  DD ...
```

```
//IFCID083  DD ...
//IFCID106  DD ...
//IFCID140  DD ...
//IFCID141  DD ...
//IFCID142  DD ...
//IFCID143  DD ...
//IFCID144  DD ...
//IFCID145  DD ...
//IFCID269  DD ...
//IFCID270  DD ...
//IFCID350  DD ...
//IFCID361  DD ...
//IFCID362  DD ...
```

PSPI

DSN1SMFP output

PSPI Use this utility to aid in determining and correcting system security problems. When diagnosing DB2, you might need to refer to licensed documentation to interpret output from this utility.

DSN1SMFP generates up to nineteen types of reports, according to the input, plus an end-of-job summary report. Each type of report is triggered by a particular IFCID type. Each occurrence of a recognized IFCID type causes a new report to be appended to any earlier report that was generated in the same run. Each report begins with a standard report header. When all records have been processed, an end of job report summarizes the input that was received, which records were processed, and any error messages that were encountered along the way.

DSN1SMFP creates the following dedicated report DDs:

Table 170. DSN1SMFP dedicated report DDs

DD name	Description	Record format	Record structure
IFCID003 DD	Extracted IFCID 003 (DDF Location) records	RECFM=FBA	See "IFCID003: DDF Location" on page 1139
IFCID004 DD	Extracted IFCID 004 (Trace Start) records	RECFM=FBA	See "IFCID004: Trace Start" on page 1140
IFCID005 DD	Extracted IFCID 005 (Trace Stop) records	RECFM=FBA	See "IFCID005: Trace Stop" on page 1140
IFCID023 DD	Extracted IFCID 023 (Utility Start) records	RECFM=FBA	See "IFCID023: Utility Start" on page 1141
IFCID024 DD	Extracted IFCID 024 (Utility Change) records	RECFM=FBA	See "IFCID024: Utility Change" on page 1144
IFCID025 DD	Extracted IFCID 025 (Utility End) records	RECFM=FBA	See "IFCID025: Utility End" on page 1145
IFCID083 DD	Extracted IFCID 083 (Identify End) records	RECFM=FBA	See "IFCID083: Identify End" on page 1146
IFCID106 DD	Extracted IFCID 106 (System Parameters) records (security-relevant fields only)	RECFM=FBA	See "IFCID106: System Parameters (security-relevant fields only)" on page 1147
IFCID140 DD	Extracted IFCID 140 (Audit Authorization Failures) records	RECFM=FBA	See "IFCID140: Audit Authorization Failures" on page 1156

Table 170. DSN1SMFP dedicated report DDs (continued)

DD name	Description	Record format	Record structure
IFCID141 DD	Extracted IFCID 141 (Audit DDL Grant/Revoke) records	RECFM=FBA	See "IFCID141: Audit DDL Grant/Revoke" on page 1162
IFCID142 DD	Extracted IFCID 142 (Audit DDL Create/Alter/Drop) records	RECFM=FBA	See "IFCID142: Audit DDL Create/Alter/Drop" on page 1163
IFCID143 DD	Extracted IFCID 143 (Audit First Write) records	RECFM=FBA	See "IFCID143: Audit First Write" on page 1165
IFCID144 DD	Extracted IFCID 144 (Audit First Read) records	RECFM=FBA	See "IFCID144: Audit First Read" on page 1166
IFCID145 DD	Extracted IFCID 145 (Audit DML Statement) records	RECFM=FBA	See "IFCID145: Audit DML Statement" on page 1166
IFCID269 DD	Extracted IFCID 269 (Trusted Connection) records	RECFM=FBA	See "IFCID269: Trusted Connection" on page 1168
IFCID270 DD	Extracted IFCID 270 (Trusted Context) records	RECFM=FBA	See "IFCID270: Trusted Context" on page 1170
IFCID350 DD	Extracted IFCID 350 (SQL Statement) records	RECFM=FBA	See "IFCID350: SQL Statement" on page 1170
IFCID361 DD	Extracted IFCID 361 (Audit Administrative Authorities) records	RECFM=FBA	See "IFCID361: Audit Administrative Authorities" on page 1172
IFCID362 DD	Extracted IFCID 362 (Trace Start and Stop with AUDITPOLICY) records	RECFM=FBA	See "IFCID362: Trace Start and Stop with AUDITPOLICY" on page 1176
SYSPRINT DD	Runtime messages and EOJ summary	RECFM=FBA	See "SYSPRINT: Runtime messages and end-of-job summary" on page 1178

For details about the record structure of the DSN1SMFP output, see "DSN1SMFP output record structure." PSPI

DSN1SMFP output record structure

The DSN1SMFP utility extracts, formats, and prints SMF records to dedicated report records. Each trace type report record has a different structure.

Standard report header

Each report, except the end-of-job report, begins with the standard report header.

Fields

PSPI The standard report header has the following fields:

PRIMAUTH
The authorization ID under which the transaction is running.

Field Name: QWHCAID

ORIGAUTH
The original authorization ID under which the transaction started.

Field Name: QWHCOPID

PLANNAME
The DB2 plan name.

Field Name: QWHCPLAN

CONNECT
The connection ID.

Field Name: QWHCCN

CORRNAME
The correlation name.

Field Name: QWHCCV

CORRNMBR
The correlation number.

Field Name: QWHCCV

INSTANCE
The unique number that is assigned to a thread.

Field Name: QWHSLUUV

CONNTYPE
The type of connection that is being used to interface with DB2.

Field Name: QWHATYP

END_USER
The user ID of the workstation user.

Field Name: QWHCEUID

RECORD TIME
The timestamp that is contained in the trace record. The format is hours, minutes, seconds, and hundred-millionths of a second.

Field Name: QWHSSTCK

TCB CPU TIME
The CPU time that is stored in the trace record. The format is minutes, seconds, and hundred- millionths of a second.

Field Name: QWHUCPU

WS_NAME
The name of the workstation.

Field Name: QWHCEUWN

DESTNO
The destination sequence number.

Field Name: QWHSWSEQ

IFCID The instrumentation facility component identification (DB2 trace record type).

Field Name: QWHSIID

DESCRIPTION
A brief description of the IFCID record. The description indicates whether the record contains accounting, statistics, or performance data. For performance data, the description also indicates the event.

TRANSACT
The name of the workstation transaction.

Field Name: QWHCEUTX

Example

```
PRIMAUTH CONNECT  INSTANCE       END_USER      WS_NAME                       TRANSACT
ORIGAUTH CORRNAME CONNTYPE       RECORD TIME   DESTNO     IFC DESCRIPTION    DATA
PLANNAME CORRNMBR                TCB CPU TIME             ID
-------- -------- ------------ -------------------------- --- -------------- ---------------
SYSADM   BATCH    X'BFE0F0E22787'
SYSADM   CCTRACE4 TSO          01:02:39        0000006030 003 DDF Data by Location
DSNBIND  'BLANK'
```

PSPI

IFCID003: DDF Location

The IFCID003 DD contains the extracted IFCID 003 (DDF Location) records. Only IFCID 0003 records that contain a distributed data facility statistics (DSNDQLAC) block are reported; other IFCID 0003 records are ignored. Only selected IFCID 0003 fields are used.

Fields

PSPI The IFCID003 DD has the following fields:

REMOTE LOCATION
The name of the remote location that this information is associated with. If the local location is the requester, this field is a server location. If the local location is a server location, this field is the requester location. An allied thread is created at a DB2 requester, and a database access thread is created at a DB2 server. An accounting record is for either a requester or a server, but not for both.

Field Name: QLACLOCN

COMMIT SENT
The number of single-phase commit requests that are sent to the server location. This value is maintained at the requester location.

Field Name: QLACCOMS

COMMIT RECEIVED
The number of single-phase commit requests that are received from the requester location. This value is maintained at the server location.

Field Name: QLACCOMR

REQ.ELAPSED TIME
The elapsed time at the requester location until the database access agent completed its work, including DB2 processing time and network time. This value is maintained at the requester location and is calculated by accumulating the difference between the store clock values that are obtained before and after each network request.

Field Name: QLACCPUL

ROLLBK SENT
The number of rollback requests that were sent to the server location (single-phase commit operations only). This value is maintained at the requester location.

Field Name: QLACABRS

SER.ELAPSED TIME
The elapsed database access agent time at the server location. This time is updated at the requester location and is reported only for DB2 private protocol. If the agent uses both methods to communicate with the server location, only the elapsed time that is associated with the DB2 private protocol is reported, and this time can be misleading. If only DRDA is used, this value is 0.

Field Name: QLACCPUR

ROLLBK RECEIVED
The number of rollback requests that are received from the requester location (single-phase commit operations only). This value is maintained at the server location.

Field Name: QLACABRR

Example

```
   DDF DATA BY LOCATION
REMOTE LOCATION    COMMIT SENT
                   COMMIT RECEIVED
REQ.ELAPSED TIME   ROLLBK SENT
SER.ELAPSED TIME   ROLLBK RECEIVED
---------------------------------
STLEC1B                 0000000000
                        0000000000
09:48:00                0000000000
09:48:00                0000000000
```

PSPI

IFCID004: Trace Start

The IFCID004 DD contains the extracted IFCID 004 (Trace Start) records.

Fields

PSPI The IFCID004 DD has the following fields:

MESSAGE
The start trace message.

Field Name: QW0004MS

QW0004CM
For serviceability only.

Field Name: QW0004CM

Example

```
MESSAGE : -START TRACE (AUDIT )AUDTPLCY (VLDPLCY )CLASS (* )RMID (* )DEST (SMF )PLAN (* )AUTHID (* )IFCID (* )BUFSIZE (* )USERID (*
          )APPNAME (* )WRKSTN (* )PKGLOC (* )PKGCOL (* )PKGPROG (* )CONNID (* )CORRID (* )ROLE (* )..
QW0004CM: X'60E2E3C1D9E340E3'
```

PSPI

IFCID005: Trace Stop

The IFCID005 DD contains the extracted IFCID 005 (Trace Stop) records.

Fields

PSPI The IFCID005 DD has the following fields:

MESSAGE
The stop trace message.

Field Name: QW0004MS

QW0005CM
For serviceability only.

Field Name: QW0005CM

Example

```
MESSAGE : -STOP TRACE (AUDIT )CLASS (* )RMID (* )PLAN (* )AUTHID (* )TNO (* )USERID (* )APPNAME (* )WRKSTN (* )PKGLOC (* )PKGCOL (*
          )PKGPROG (* )CONNID (* )CORRID (* )ROLE (* )..
QW0005CM: X'60E2E3D6'
```

PSPI

IFCID023: Utility Start

The IFCID023 DD contains the extracted IFCID 023 (Utility Start) records.

Fields

PSPI The IFCID023 DD has the following fields:

DBID The database ID.

Field Name: QW0023DB

UTILITY NAME
The utility name.

Field Name: QW0023NM

OBID The object ID.

Field Name: QW0023PD

UTILITY PHASE
The phase name of the utility.

Field Name: QW0023PH

RQSTASK
The number of requested subtasks.

Field Name: QW0023R1

UTILITY ID
The identifier of the utility.

Field Name: QW0023ID

REORG KEEPDICTIONARY
The REORG utility is specified with the KEEPDICTIONARY keyword.

Field Name: QW0023D1

LOAD KEEPDICTIONARY
The LOAD utility is specified with the KEEPDICTIONARY keyword.

Field Name: QW0023B1

COPY CONCURRENT
The COPY utility is specified with the CONCURRENT keyword.

Field Name: QW0023A1

REBUILD REUSE
The REBUILD utility is specified with the REUSE keyword.

Field Name: QW0023F1

REORG REUSE
The REORG utility is specified with the REUSE keyword.

Field Name: QW0023D2

LOAD REUSE
The LOAD utility is specified with the REUSE keyword.

Field Name: QW0023B2

COPY SHRLEVEL CHANGE
The COPY utility is specified with the SHRLEVEL(CHANGE) keyword.

Field Name: QW0023A2

REBUILD SORTKEYS
The REBUILD utility is specified with the SORTKEYS keyword.

Field Name: QW0023F2

REORG LOG NO
The REORG utility is specified with the LOG(NO) keyword.

Field Name: QW0023D3

LOAD LOG NO
The LOAD utility is specified with the LOG(NO) keyword.

Field Name: QW0023B3

COPY PARALLEL
The COPY utility is specified with the PARALLEL keyword.

Field Name: QW0023A3

REBUILD STATISTICS
The REBUILD utility is specified with the STATISTICS keyword.

Field Name: QW0023F3

REORG SORTKEYS
The REORG utility is specified with the SORTKEYS keyword.

Field Name: QW0023D4

LOAD SORTKEYS
The LOAD utility is specified with the SORTKEYS keyword.

Field Name: QW0023B4

COPY CHECKPAGE
The COPY utility is specified with the CHECKPAGE keyword.

Field Name: QW0023A4

REBUILD WORKDDN
The REBUILD utility is specified with the WORKDDN keyword.

Field Name: QW0023F4

REORG SORTDATA
The REORG utility is specified with the SORTDATA keyword.

Field Name: QW0023D5

LOAD SHRLEVEL CHANGE
The LOAD utility is specified with the SHRLEVEL(CHANGE) keyword.

Field Name: QW0023B5

REORG NOSYSREC
The REORG utility is specified with the NOSYSREC keyword.

Field Name: QW0023D6

LOAD COPYDDN
The LOAD utility is specified with the COPYDDN keyword.

Field Name: QW0023B6

RECOVER REUSE
The RECOVER utility is specified with the REUSE keyword.

Field Name: QW0023A7

RUNSTATS SAMPLE
The RUNSTATS utility is specified with the SAMPLE keyword.

Field Name: QW0023G1

REORG SHRLEVEL CHANGE
The REORG utility is specified with the SHRLEVEL(CHANGE) keyword.

Field Name: QW0023D7

LOAD STATISTICS
The LOAD utility is specified with the STATISTICS keyword.

Field Name: QW0023B7

RECOVER PARALLEL
The RECOVER utility is specified with the PARALLEL keyword.

Field Name: QW0023A8

RUNSTATS SHRLEVEL CHANGE
The RUNSTATS utility is specified with the SHRLEVEL(CHANGE) keyword.

Field Name: QW0023G2

REORG SHRLEVEL REFERENCE
The REORG utility is specified with the SHRLEVEL(REFERENCE) keyword.

Field Name: QW0023D8

LOAD PART INDDN
The LOAD utility is specified with the PART(INDDN) keyword.

Field Name: QW0023B8

REORG COPYDDN
The REORG utility is specified with the COPYDDN keyword.

Field Name: QW0023E1

UNLOAD SHRLEVEL REFERENCE
The UNLOAD utility is specified with the SHRLEVEL(REFERENCE) keyword.

Field Name: QW0023H1

REORG STATISTICS
The REORG utility is specified with the STATISTICS keyword.

Field Name: QW0023E2

UNLOAD SHRLEVEL CHANGE ISOLATION CS
The UNLOAD utility is specified with the SHRLEVEL(CHANGE ISOLATION CS) keyword.

Field Name: QW0023H2

REORG FASTSWITCH
The REORG utility is specified with the FASTSWITCH keyword.

Field Name: QW0023E3

UNLOAD SHRLEVEL CHANGE ISOLATION UR
The UNLOAD utility is specified with the SHRLEVEL(CHANGE ISOLATION UR) keyword.

Field Name: QW0023H3

Example

```
DBID   :       00000    UTILITY NAME : REORG
OBID   :       00000    UTILITY PHASE: UTILINIT
RQSTASK:  0000000000    UTILITY ID   : NNCCC1A3.REORG1
REORG KEEPDICTIONARY    : NO   LOAD KEEPDICTIONARY : NO   COPY CONCURRENT     : NO   REBUILD REUSE     : NO
REORG REUSE             : NO   LOAD REUSE          : NO   COPY SHRLEVEL CHANGE: NO   REBUILD SORTKEYS  : NO
REORG LOG NO            : YES  LOAD LOG NO         : NO   COPY PARALLEL       : NO   REBUILD STATISTICS: NO
REORG SORTKEYS          : YES  LOAD SORTKEYS       : NO   COPY CHECKPAGE      : NO   REBUILD WORKDDN   : NO
REORG SORTDATA          : YES  LOAD SHRLEVEL CHANGE: NO
REORG NOSYSREC          : YES  LOAD COPYDDN        : NO   RECOVER REUSE       : NO   RUNSTATS SAMPLE   : NO
REORG SHRLEVEL CHANGE   : NO   LOAD STATISTICS     : NO   RECOVER PARALLEL    : NO   RUNSTATS SHRLEVEL CHANGE: NO
REORG SHRLEVEL REFERENCE: YES                             LOAD PART INDDN     : NO
REORG COPYDDN           : YES                             UNLOAD SHRLEVEL REFERENCE          : NO
REORG STATISTICS        : YES                             UNLOAD SHRLEVEL CHANGE ISOLATION CS: NO
REORG FASTSWITCH        : YES                             UNLOAD SHRLEVEL CHANGE ISOLATION UR: NO
```

PSPI

IFCID024: Utility Change

The IFCID024 DD contains the extracted IFCID 024 (Utility Change) records.

Fields

PSPI The IFCID024 DD has the following fields:

DBID The database ID.

Field Name: QW0024DB

UTILITY NAME
The utility name.

Field Name: QW0024NM

OBID The object ID.

Field Name: QW0024PD

UTILITY PHASE
The phase name of the utility.

Field Name: QW0024PH

ITEMS
The number of items processed by the utility.

Field Name: QW0024DN

UTILITY ID
The identifier of the utility.

Field Name: QW0024ID

DBNAME
The database name.

Field Name: QW0024NA

OBJECT NAME
The table space name or index name.

Field Name: QW0024PN

PART/DATASET#
The number of the partition or data set if the utility is operating on one partition or data set. Otherwise, the value of this field is 0.

Field Name: QW0024PN

Example

```
DBID  :                 00269  UTILITY NAME : REORG
OBID  :                 00002  UTILITY PHASE: UNLOAD
ITEMS :  00000000000000000000  UTILITY ID   : NNCCC1A3.REORG1
DBNAME:  DBCCDB2A              OBJECT NAME  : TSCCDB2A
PART/DATA SET#:    0000000000
```

PSPI

IFCID025: Utility End

The IFCID025 DD contains the extracted IFCID 025 (Utility End) records.

Fields

PSPI The IFCID025 DD has the following fields:

DBID The database ID.

Field Name: QW0025DB

UTILITY NAME
The utility name.

Field Name: QW0025NM

OBID The object ID.

Field Name: QW0025PD

UTILITY PHASE
The phase name of the utility.

Field Name: QW0025PH

ITEMS
The number of items that are processed by the utility.

Field Name: QW0025DN

UTILITY ID
The identifier of the utility.

Field Name: QW0025ID

Example

```
DBID :                  00269  UTILITY NAME : REORG
OBID :                  00002  UTILITY PHASE:
ITEMS:   00000000000000000004  UTILITY ID   : NNCCC1A3.REORG1
```

PSPI

IFCID083: Identify End

The IFCID083 DD contains the extracted IFCID 083 (Identify End) records.

Fields

PSPI The IFCID083 DD has the following fields:

RECOPT
The record coordination option specification.

Field Name: QW0083RO

ACCESS
Whether the access was successful.

Field Name: QW0083AD

CURR SQLID
The current SQL authorization ID.

Field Name: QW0083QD

ORIG AUTHID
The original primary authorization ID.

Field Name: QW0083OP

SECONDARY AUTHORIZATION IDS
The list of the secondary authorization IDs. This list is only produced if there are secondary authorization IDs.

Field Name: QW0083SA

ACEE UTOKEN
The ACEE UTOKEN.

Field Name: QW0083UT

RETURN CODE
The return code.

Field Name: QW0083RT

REASON CODE
The reason code.

Field Name: QW0083RS

CONNECTION TYPE
The connection type.

Field Name: QW0083CT

Example

```
END          RECOPT     : '...'
             ACCESS     : SUCCESSFUL
             CURR SQLID : USRT005
             ORIG AUTHID: USRT005
             SECONDARY AUTHORIZATION IDS:
             ACEE UTOKEN: &.....H.SYSHIGH STLVM3  JES2    STLVM3  SYS1    RDR1    ........USRT005 SYS1
             RETURN CODE:  0000000000
             REASON CODE:  0000000000
             CONNECTION TYPE: X'C2C1E3C3C8404040'
```

PSPI

IFCID106: System Parameters (security-relevant fields only)

The IFCID106 DD contains the extracted IFCID106 (System Parameters) records.

PSPI The IFCID106 DD has the following five sections for the security-relevant fields:

- System initialization parameters
- Miscellaneous installation parameters
- Distributed Data Facility (DDF) parameters
- Data sharing parameters
- Application programming defaults

Fields for system initialization parameters

The IFCID106 DD has the following fields for system initialization parameters:

WTO ROUTE CODES
The MVS console routing codes. These codes are assigned to messages that are not solicited from a specific console. Up to 16 comma-separated codes can be shown.

Install parameter: WTO ROUTE CODES on panel DSNTIPO

DSN6SYSP parameter: ROUTCDE

Field Name: QWP1SMRC

MONITOR BUFFER SIZE
The default number of bytes allocated for the monitor trace buffer.

Install parameter: MONITOR SIZE on panel DSNTIPN

DSN6SYSP parameter: MONSIZE

Field Name: QWP1MONS

AUDIT CLASSES
Shows whether the audit trace is started automatically when DB2 is started. When a value of YES is specified, the audit trace is started for the default class (class 1) whenever DB2 is started. When a value of ALL is specified, an audit trace is automatically started for all classes.

Install parameter: AUDIT TRACE on panel DSNTIPN

DSN6SYSP parameter: AUDITST

Field Name: QWP1AUDT

EXT. SECURITY
Extended security options. When the recommended value of YES is specified, detailed reason codes are returned to a DRDA level 3 client when a DDF connection request fails because of security errors. When using SNA protocols, the requester must have included a product that supports the extended security sense codes, such as DB2 Connect™ version 5 and subsequent releases. RACF users can change their passwords using the DRDA change password function. This support is only for DRDA level 3 requesters that have implemented support for changing passwords. A value of YES allows properly-enabled DRDA clients to determine the cause of security failures without requiring DB2 operator support. When a value of NO is specified, generic error codes are returned to the clients and RACF users are prevented from changing their passwords.

Install parameter: EXTENDED SECURITY on panel DSNTIPR

DSN6SYSP parameter: EXTSEC

Field Name: QWP1SCER

UNICODE IFCIDS
Shows whether output from IFC records should contain character data in Unicode or EBCDIC. Only a subset of the character fields (identified in the IFCID record definition by a %U in the comment area to the right of the field declaration in the DSNDQWxx copy files) are encoded in Unicode. The remaining fields maintain the same encoding of previous releases.

Install parameter: UNICODE IFCIDS on panel DSNTIPN

DSN6SYSP parameter: UIFCIDS

Field Name: QWP1_UNICODE

Example for system initialization parameters

```
|                                SYSTEM INITIALIZATION PARAMETERS
| WTO ROUTE CODES  : X'8000'  MONITOR BUFFER SIZE:  0001048576  AUDIT CLASSES: X'00000000'  EXT. SECURITY: NO
| DATABASE PROTOCOL: D        UNICODE IFCIDS     :  NO
```

Fields for miscellaneous installation parameters

The IFCID106 DD has the following fields for miscellaneous installation parameters:

COMCRIT
Indicates whether the DB2 environment for Common Criteria is enabled.

Install parameter: None

DSN6SPRM parameter: COMCRIT

Field name: QWP4COMC

DDL REGISTRATION FLAG
The DDL registration facility flag. It summarizes four settings for data definition control support:

Data definition control
Indicates whether DDL statements are validated by data definition control support.

Install parameter: INSTALL DD CONTROL SUPT on panel DSNTIPZ

DSN6SPRM parameter: RGFINSTL

Application control
Indicates whether the DB2 system is controlled by a set of closed applications whose application identifiers are identified in the application registration table. Closed applications require their DB2 objects to be managed solely through the plans or packages of the closed application that is registered in the application registration table.

Install parameter: CONTROL ALL APPLICATIONS on panel DSNTIPZ

DSN6SPRM parameter: RGFDEDPL

Full names required
Indicates whether registered objects require fully-qualified names.

Install parameter: REQUIRE FULL NAMES on panel DSNTIPZ

DSN6SPRM parameter: RGFFULLQ

Unregistered DDL action
Indicates whether DDL that names an unregistered object is to be rejected, rejected if the current application is not registered, or accepted.

Install parameter: UNREGISTERED DDL DEFAULT on panel DSNTIPZ

DSN6SPRM parameter: RGFDEFLT

DDL REGISTRATION FLAG can have one of the following values:

Setting	Interpretation			
	Data definition control	**Application control**	**Full names required**	**Unregistered DDL action**
00	No	No	No	Reject
08				Application
10				Accept
20			Yes	Reject
28				Application
30				Accept
40		Yes	No	Reject
48				Application
50				Accept
60			Yes	Reject
68				Application
70				Accept

Setting	Interpretation			
	Data definition control	Application control	Full names required	Unregistered DDL action
80	Yes	No	No	Reject
88				Application
90				Accept
A0			Yes	Reject
A8				Application
B0				Accept
C0		Yes	No	Reject
C8				Application
D0				Accept
E0			Yes	Reject
E8				Application
F0				Accept

Field Name: QWP4REGF

INSTALL SYSADM
One of two authorization IDs with SYSADM authority. SYSADM users can access to DB2 in all cases.

Install parameter: SYSTEM ADMIN 1 on panel DSNTIPP1

DSN6SPRM parameter: SYSADM

Field Name: QWP4SADM

DEFAULT USERID
The authorization ID used if RACF is not available for batch access and USER= is not specified in the job statement.

Install parameter: UNKNOWN AUTHID on panel DSNTIPP1

DSN6SPRM parameter: DEFLTID

Field Name: QWP4DFID

SYSADM ID 2
One of two authorization IDs with SYSADM authority. SYSADM users can access to DB2 in all cases.

Install parameter: SYSTEM ADMIN 2 on panel DSNTIPP1

DSN6SPRM parameter: SYSADM2

Field Name: QWP4ADM2

SITE TYPE
Shows whether this system is at a local site or a recovery site.

LOCALSITE
This is the site of the current system. Multiple image copies are made and are operational here. This is the default.

RECOVERYSITE
This an alternative site for recovery purposes.

Install parameter: SITE TYPE on panel DSNTIPO

DSN6SPRM parameter: SITETYP

Field Name: QWP4MSTY

SYSOPER ID
One of two authorization IDs with SYSOPR authority. SYSOPR users can access DB2 even if the DB2 catalog is unavailable.

Install parameter: SYSTEM OPERATOR 1 on panel DSNTIPP1

DSN6SPRM parameter: SYSOPR1

Field Name: QWP4OPR1

SYSOPER ID 2
One of two authorization IDs with SYSOPR authority. SYSOPR users can access DB2 even if the DB2 catalog is unavailable.

Install parameter: SYSTEM OPERATOR 2 on panel DSNTIPP1

DSN6SPRM parameter: SYSOPR2

Field Name: QWP4OPR2

ENABLE DB2 AUTHORIZATION
Shows whether DB2 performs authorization checking. When all authorization checking by DB2 is disabled, the GRANT statement is also disabled (granting every privilege to PUBLIC); this is not recommended.

Install parameter: USE PROTECTION on panel DSNTIPP

DSN6SPRM parameter: AUTH

Field Name: QWP4AUTH

CACHE DYNAMIC SQL
Indicates whether prepared dynamic use by eligible application processes.

Install parameter: CACHE DYNAMIC on panel DSNTIP8

DSN6SPRM parameter: CACHEDYN

Field Name: QWP4CDYN

AUTH. CACHE SIZE
The size of the authorization cache to use if no CACHESIZE is specified on the BIND PLAN subcommand. A value of 0 means authorization caching is not used.

Install parameter: PLAN AUTH CACHE on panel DSNTIPP

DSN6SPRM parameter: AUTHCACH

Field Name: QWP4AUCA

PACK AUTH CACHE
The amount of storage that is allocated for caching authorization information for all packages on this DB2 member.

Install parameter: PACKAGE AUTH CACHE on panel DSNTIPP

DSN6SPRM parameter: CACHEPAC

Field Name: QWP4PAC

DBADM CREATE VIEW
Shows whether a DB2 administrator can create a view or alias for another user. Possible values are YES or NO. The default value is NO.

Install parameter: DBADM CREATE AUTH on panel DSNTIPP1

DSN6SPRM parameter: DBACRVW

Field Name: QWP4CRVW

EDM STATEMNT CACHE
The size of the statement cache that can be used by the Environmental Descriptor Manager (EDM).

Install parameter: EDM STATEMENT CACHE on panel DSNTIPC

DSN6SPRM parameter: EDMSTMTC

Field Name: QWP4ESTC

ONL SYSPARM TYPE
The type of DB2 system parameter that was changed by the last SET SYSPARM statement.

Install parameter: None

DSN6SPRM parameter: None

Field Name: QWP4OZTP

ONL SYSPARM USER ID
The user ID that made the last online change to DB2 system settings.

Install parameter: None

DSN6SPRM parameter: None

Field Name: QWP4OZUS

ONL SYSPARM CORID
The correlation ID of the online application that made the last change to DB2 system settings.

Install parameter: None

DSN6SPRM parameter: None

Field Name: QWP4OZCI

ONL SYSPARM TIME
Time of the last online change made to DB2 system settings.

Install parameter: None

DSN6SPRM parameter: None

Field Name: QWP4OZTM

SECURITY ADMIN 1 TYPE
Specifies whether the entry in the SECURITY ADMIN 1 field is an authorization ID or a role.

Install parameter: SEC ADMIN 1 TYPE field on panel DSNTIPP1

DSN6SPRM parameter: SECADM1_TYPE

Field Name: QWP4SECA1_Type

SECURITY ADMIN 2 TYPE
Specifies whether the entry in the SECURITY ADMIN 2 field is an authorization ID or a role.

Install parameter: SEC ADMIN 2 TYPE field on panel DSNTIPP1

DSN6SPRM parameter: SECADM2_TYPE

Field Name: QWP4SECA2_Type

SECURITY TASKS

Specifies whether DB2 security administrator duties are to be separated from system administrator duties for this subsystem. You must set the SEPARATE_SECURITY system parameter to YES in the evaluated configuration.

Install parameter: SEPARATE SECURITY field on panel DSNTIPP1

DSN6SPRM parameter: SEPARATE_SECURITY

Field Name: QWP4SEPSD

REVOKE DEP. PRIVILEGES

Specifies whether revoking a privilege from a user is to cause dependent privileges to be revoked. If dependent privileges are to be revoked, revoking a privilege from a user also revokes the privilege from anyone that the user has granted that privilege to.

Install parameter: REVOKE DEP PRIV field on panel DSNTIPP1

DSN6SPRM parameter: REVOKE_DEP_PRIVILEGES

Field Name: QWP4RVDPR

SECURITY ADMIN 1

The first of two authorization IDs or roles that are assigned to have DB2 security administrator authority.

Install parameter: SECURITY ADMIN 1 on panel DSNTIPP1

DSN6SPRM parameter: SECADM1

Field Name: QWP4SECA1

SECURITY ADMIN 2

The second of two authorization IDs or roles that are assigned to have DB2 security administrator authority.

Install parameter: SECURITY ADMIN 2 on panel DSNTIPP1

DSN6SPRM parameter: SECADM2

Field Name: QWP4SECA2

Example for miscellaneous installation parameters

```
                                MISCELLANEOUS INSTALLATION PARAMETERS
COMMON CRITERIA ENVIRON : YES           DDL REGISTRATION FLAG: X'30'     INSTALL SYSADM  : SYSADM1      DEFAULT USERID    : IBMUSER
SYSADM ID 2             : SYSADM2       SITE TYPE            : LOCAL     SYSOPER ID      : SYSOPR1      SYSOPER ID 2      : SYSOPR2
ENABLE DB2 AUTHORIZATION: YES           CACHE DYNAMIC SQL    : NO        AUTH. CACHE SIZE:  01024
PACK AUTH CACHE         :  0000000000   DBADM CREATE VIEW    : YES       EDM STMT CACHE  :  0000005000  ONL SYSPARM TYPE  : N/A
ONL SYSPARM CORID       :               ONL SYSPARM USER ID  :           ONL SYSPARM TIME: 08:26:40
SECURITY ADMIN 1 TYPE   : AUTH ID       SECURITY ADMIN 2 TYPE: AUTH ID   SECURITY TASKS  : SYSADM/SYSCTRL CANNOT GRANT/REVOKE
REVOKE DEP. PRIVILEGES  : SPECIFIED IN REVOKE STATEMENT
SECURITY ADMIN 1        : SECADM
SECURITY ADMIN 2        : SECADM

                                MISCELLANEOUS INSTALLATION PARAMETERS
COMMON CRITERIA ENVIRON : NO            DDL REGISTRATION FLAG: X'30'     INSTALL SYSADM  : SYSADM       DEFAULT USERID    : IBMUSER
SYSADM ID 2             : SYSADM        SITE TYPE            : LOCAL     SYSOPER ID      : SYSOPR       SYSOPER ID 2      : SYSOPR
ENABLE DB2 AUTHORIZATION: YES           CACHE DYNAMIC SQL    : NO        AUTH. CACHE SIZE:  01024       HOP SITE AUTHORIZ.: YES
PACK AUTH CACHE         :  0000032768   DBADM CREATE VIEW    : NO        EDM STMT CACHE  :  0005120000  ONL SYSPARM TYPE  : N/A
ONL SYSPARM CORID       :               ONL SYSPARM USER ID  :           ONL SYSPARM TIME: 08:26:40
```

Fields for DDF parameters

The IFCID106 DD has the following fields for DDF parameters:

FACILITY NAME
The name of the DDF facility.

Install parameter: None

DSN6FAC parameter: None

Field Name: QWP9NAME

RESYNCH.INTERVAL
The number of minutes between resynchronization periods.

Install parameter: RESYNC INTERVAL on panel DSNTIPR

DSN6FAC parameter: RESYNC

Field Name: QWP9RYC

TCP/IP VERIFIED
Indicates whether DB2 accepts TCP/IP connection requests containing only a user ID.

Install parameter TCP/IP ALREADY VERIFIED on panel DSNTIP5

DSN6FAC parameter: TCPALVER

Field Name: QWP9TCPA

FACILITY START
Indicates whether DDF is loaded, and if so, how it was started.

Install parameter DDF STARTUP OPTION on panel DSNTIPR

DSN6FAC parameter: DDF

Field Name: QWP9STRT

DBAT STATUS
Shows whether DB2 inactivates threads that have successfully committed or rolled back, and hold no cursors.

Install parameter DDF THREADS on panel DSNTIPR

DSN6FAC parameter: CMTSTAT

Field Name: QWP9CMST

TCP/IP KEEPALIVE
Indicates whether the TCP/IP configuration KeepAlive value has been overwritten.

Install parameter TCP/IP KEEPALIVE on panel DSNTIP5

DSN6FAC parameter: TCPKPALV

Field Name: QWP9TCKA

Example for DDF parameters

```
|                                DISTRIBUTED DATA FACILITY PARAMETERS
|  FACILITY NAME: DDF       RESYNCH.INTERVAL: 00002     TCP/IP VERIFIED: NO        FACILITY START: AUTO
|  DBAT STATUS  : INACTIVE  TCP/IP KEEPALIVE: ENABLE
```

Fields for data sharing parameters

The IFCID106 DD has the following fields for data sharing parameters:

GROUP NAME
The name of the DB2 data-sharing group. A value of N/A indicates that this DB2 is not part of a data-sharing group.

Install parameter: GROUP NAME on panel DSNTIPK

DSN6GRP parameter: GRPNAME

Field Name: QWPAGRPN

MEMBER NAME
The member name of this DB2. A value of N/A indicates that this DB2 is not part of a data-sharing group.

Install parameter: MEMBER NAME on panel DSNTIPK

DSN6GRP parameter: MEMBNAME

Field Name: QWPAMBRN

DATA SHARING ENABLED
Indicates whether data sharing is enabled.

Install parameter: DATA SHARING on panel DSNTIP0A

DSN6GRP parameter: DSHARE

Field Name: QWPADSHR

PAR.COORD
Shows whether this DB2 member can coordinate parallel processing on other members of the group. A value of N/A indicates that this DB2 is not part of a data-sharing group.

Install parameter: COORDINATOR on panel DSNTIPK

DSN6GRP parameter: COORDNTR

Field Name: QWPACOOR

PAR.ASSIST
Shows whether this DB2 member can assist a parallelism coordinator with parallel processing. A value of N/A indicates that this DB2 is not part of a data-sharing group.

Install parameter: ASSISTANT on panel DSNTIPK

DSN6GRP parameter: ASSIST

Field Name: QWPAASST

Example for data sharing parameters

```
                    DATA SHARING PARAMETERS
GROUP NAME: DSNCAT    MEMBER NAME: DB2A     DATA SHARING ENABLED: NO   PAR.COORD: NO
PAR.ASSIST: NO
```

Fields for application programming defaults

The IFCID106 DD has the following fields for application programming defaults:

VERSION
The version, release, and modification level.

Install parameter: None

DSNHDECP parameter: None

Field Name: QWPBREL

DEFAULT SUBSYSTEM
The MVS subsystem name for DB2.

Install parameter: SUBSYSTEM NAME on panel DSNTIPM

DSNHDECP parameter: SSID

Field Name: QWPBSSID

EBCDIC SBCS CCSID
The EBCDIC single-byte coded character set ID.

Install parameter: EBCDIC CCSID on panel DSNTIPF

DSNHDECP parameter: SCCSID

Field Name: QWPBSID

DECIMAL POINT OPTION
Indicates whether the decimal contains a comma (,) or a period (.).

Install parameter: DECIMAL POINT IS on panel DSNTIPF

DSNHDECP parameter: DECIMAL

Field Name: QWPBDE

DEFAULT ENCODING SCHEME
The default encoding scheme, which can be ASCII, EBCDIC, or UNICODE.

Install parameter: DEF ENCODING SCHEME on panel DSNTIPF

DSNHDECP parameter: ENSCHEME

Field Name: QWPBENS

Example for application programming defaults

```
                          APPLICATION PROGRAMMING DEFAULTS
VERSION            : 1110    DEFAULT SUBSYSTEM      : DB2A     EBCDIC SBCS CCSID: 00037
DECIMAL POINT OPTION: PERIOD  DEFAULT ENCODING SCHEME: EBCDIC
```

PSPI

IFCID140: Audit Authorization Failures

The IFCID140 DD contains the extracted IFCID 140 (Audit Authorization Failures) records.

Fields

PSPI The IFCID140 DD has the following fields:

AUTH CHECKED
The authorization ID that is being checked.

Field Name: QW0140UR

AUTHID TYPE
The authorization ID type.

Field Name: QW0140AT

REASON
The user-defined reason code from the access control authorization exit routine.

Field Name: QW0140RS

STATMNT LENGTH
The length of the failing SQL statement plus 4. It has a value of zero if no SQL statement exists.

Field Name: QW0140LL

RETCOD
The return code from the access control authorization exit routine.

Field Name: QW0140RC

PRIV CHECKED
The privilege that is being checked. It can have the following values:

- ALL ON PACKAGES
- ALLPKAUT
- ALTER
- ALTER BUFFERPOOL
- ALTER INDEX
- ALTERIN
- ARCHIVE
- BIND ADD
- BIND, REBIND OR FREE
- BINDAGENT
- CHECK DATA UTILITY
- CHECK UTILITY
- COMMENT ON
- COMMENT ON INDEX
- COPY
- COPY PACKAGE
- CREATE ALIAS
- CREATE GLOBAL TEMPORARY TABLE (CREATETMTAB)
- CREATE IN
- CREATE INDEX
- CREATE SECURE OBJECT
- CREATE STOGROUP
- CREATE SYNONYM
- CREATE TABLE
- CREATE TABLESPACE
- CREATE VIEW
- CREATEDBA
- CREATEDBC
- CREATEIN
- DBADM
- DBCTRL
- DBMAINT
- DDF COMMAND - START, STOP, OR CANCEL
- DEBUG SESSION
- DELETE

- DESCRIBE TABLE
- DIAGNOSE UTILITY
- DISPLAY
- DISPLAY ARCHIVE
- DISPLAY BUFFERPOOL
- DISPLAY DATABASE
- DISPLAY PROFILE
- DISPLAY RLIMIT
- DISPLAY THREAD OR DISPLAY DB
- DISPLAY UTILITY
- DROP
- DROP ALIAS
- DROP INDEX
- DROP SYNONYM
- DROPIN
- EXECUTE
- EXPLAIN
- EXPLAIN MONITOR
- EXPLICIT QUALIFIER USE
- INSERT
- LOAD
- LOCK TABLE
- MERGECOPY UTILITY
- MLS READWRITE
- MODIFY UTILITY
- MONITOR1
- MONITOR2
- OTHER
- PACKADM
- QUERY TUNING
- QUIESCE UTILITY
- READ
- RECOVER (UTILITY)
- RECOVER BSDS
- RECOVER INDOUBT
- REFERENCES
- RENAME INDEX
- RENAME TABLE
- REORG
- REPAIR
- REPAIR DBD UTILITY
- REPORT UTILITY
- RUNSTATS UTILITY
- SECADM
- SELECT

- SET ARCHIVE
- SQLADM
- START
- START DATABASE
- START DB2, STOP DB2, START DB(*) OR STOP DB(*)
- START PROFILE
- START RLIMIT
- STOP
- STOP DATABASE
- STOP OR START TRACE
- STOP PROFILE
- STOP RLIMIT
- STOSPACE UTILITY
- SUBPKAUT
- SYSADM
- SYSCTRL
- SYSOPR
- SYSOPR SYSCTRL SYSADM SECADM
- TERM UTILITY
- TERMINATE UTILITY ON DATABASE
- TRIGGER
- UPDATE
- USAGE
- USE
- VALIDATE SECLABEL
- WRITE

Field Name: QW0140PR

OBJECT

The object type. N/A is printed if there is no object type. OBJECT can have the following values:

- ACEE
- APPLICATION PLAN
- BUFFERPOOL
- COLLECTION
- DATABASE
- DISTINCT TYPE
- FUNCTION
- SESSION VARIABLE
- JAR
- PACKAGE
- PROCEDURE
- ROLE
- ROW
- SCHEMA
- SEQUENCE

- STORAGE GROUP
- TABLE OR VIEW
- TABLESPACE
- TRUSTED CONTEXT
- USER AUTH (System privileges, such as SYSADM or SYSOPR)
- N/A

Field Name: QW0140OB

OPTIONS

The options that are used in the host to check the SQL statement. The bits of this field are used as indicators. If all bits are 0, the statement is not an SQL statement. OPTIONS has the following values:

- Bit 1 Host language character string delimiter
  - 0 Apostrophe
  - 1 Quote
- Bit 2 Decimal point symbol
  - 0 Period
  - 1 Comma
- Bit 3 SQL character string delimiter
  - 0 Apostrophe
  - 1 Quote
- Bit 4 Mixed character string indicator
  - 0 No
  - 1 Yes
- Bit 5 Host language options indicator
  - 0 Do not use host language options
  - 1 Use host language options
- Bits 6 to 8 Host language indicator
  - 001 Assembler
  - 010 COBOL
  - 011 PL/I
  - 100 None - Dynamic SQL
  - 101 FORTRAN
  - 110 COBOL II
  - 111 Null - See bits 17 to 24 for the language
- Bits 9 to 16 Character set that is being used
  - 00000000 Alphanumeric
  - 00000001 Katakana
- Bits 17 to 24 Alternate host language field
  - B Assembler
  - C COBOL
  - P PL/I
  - F Fortran 2
  - 2 COBOL II
  - 3 IBM COBOL
  - 4 C++

  - D C
- Bits 25 to 28 Time option
  - 0000 None
  - 1000 Local
  - 0100 JIS
  - 0010 ISO/EUR
  - 0001 USA
- Bits 29 to 32 Date option
  - 0000 None
  - 1000 Local
  - 0100 EUR
  - 0010 ISO/JIS
  - 0001 USA
- Bit 33 Decimal
  - 0 No
  - 1 Yes
- Bits 34 to 40 Unused
- Bits 41 to 48 Remote option
  - 00000001 SQL(ALL)
  - 00000010 SQL(DB2)
- Bits 49 to 56 SQL flag option
  - 00000000 No SQLFLAG option
  - 00000001 SQLFLAG(SAA)

Field Name: QW0140HO

SOURCE OBJECT
The source object name.

Field Name: QW0140SN

SOURCE OWNER
The source object owner.

Field Name: QW0140SC

TARGET OBJECT
The target object name.

Field Name: QW0140TN

TARGET OWNER
The target object owner.

Field Name: QW0140TC

SQL STMT
The SQL statement text. Long SQL text can be truncated.

Field Name: QW0140TX

ACEE UTOKEN
Shows the ACEE UTOKEN, if it is available. If it is not available, the first word of this field contains one of the following values:

- UNABLE TO GET TOKEN
- ABEND ACCESSING ACEE

Field Name: QW0140UT

RID OF ROW
Shows the row ID (RID) of the row that is updated or deleted if the table has multilevel security.

Field Name: QW0140ID

SECLABEL OF ROW
Shows the security label of the row for a table with multilevel security.

Field Name: QW0140RL

Example

```
AUTH CHECKED : USRT004
AUTHID TYPE  : PRIMARY OR SECONDARY AUTH ID
REASON       : 0000000000        STATMNT LENGTH : 0000000176
RETCOD       :  00008            PRIV CHECKED   : SELECT
OBJECT       : TABLE OR VIEW     OPTIONS        : X'0400000000000000'
SOURCE OBJECT: SYSAUDITPOLICIES
SOURCE OWNER : SYSIBM
TARGET OBJECT:
TARGET OWNER :
SQL STMT: SELECT AUDITPOLICYNAME, CHECKING, VALIDATE, OBJMAINT, EXECUTE, CONTEXT, SECMAINT, OBJECTSCHEMA, OBJECTTYPE, OBJECTNAME FRO
          YSAUDITPOLICIES ORDER BY AUDITPOLICYNAME
ACEE UTOKEN  : &.....H.L3C234  STLVM3  JES2    STLVM3  SYS1    RDR1    ........USRT004 SYS1
RID OF ROW   :
SECLABEL OF ROW:
```

PSPI

IFCID141: Audit DDL Grant/Revoke

The IFCID141 DD contains the extracted IFCID 141 (Audit DDL Grant/Revoke) records.

Fields

PSPI The IFCID141 DD has the following fields:

GRANTOR/REVOKER
The authorization ID of the user who gave or revoked the access.

Field Name: QW0141AC and QW0141OR

REASON
The reason why access was granted or revoked.

Field Name: QW0141RE

RETURN
The SQL return code.

Field Name: QW0141CO

AUTHID TYPE
The authorization ID type. AUTHID TYPE can have the following values:

- PRIMARY OR SECONDARY AUTH ID
- ROLE

Field Name: QW0141OT

OBJECT
The object type. OBJECT can have the following values:

- ACEE
- APPLICATION PLAN

- BUFFERPOOL
- COLLECTION
- DATABASE
- DISTINCT TYPE
- FUNCTION
- SESSION VARIABLE
- JAR
- PACKAGE
- PROCEDURE
- SCHEMA
- SEQUENCE
- STORAGE GROUP
- ROLE
- ROW
- TABLE OR VIEW
- TABLESPACE
- TRUSTED CONTEXT
- USER AUTH
- N/A

Field Name: QW0141OB

OPTIONS
The options that were used in the host to check the SQL statement. The bits of this field are used as indicators. If all bits are 0, the statement is not an SQL statement. See the OPTIONS field of "IFCID140: Audit Authorization Failures" on page 1156 for a full description of the bits of this field.

Field Name: QW0141HO

SQL STMT
The SQL statement text. Long SQL text can be truncated.

Field Name: QW0141TX

Example

```
GRANTOR : SYSADM           REASON : N/A                                RETURN:  0000000562
AUTHID TYPE: PRIMARY OR SECONDARY AUTH ID
OBJECT  : APPLICATION PLAN OPTIONS: X'0400000000000000'
SQL STMT: GRANT BIND, EXECUTE ON PLAN DSNTEP2 TO PUBLIC
```

PSPI

IFCID142: Audit DDL Create/Alter/Drop

The IFCID142 DD contains the extracted IFCID 142 (Audit DDL Create/Alter/Drop) records, which contain the record of CREATE, ALTER, and DROP statements against tables that are audited or that have multilevel security defined at the row level.

Fields

PSPI The IFCID142 DD has the following fields:

AUDIT DDL
ALTER, CREATE, or DROP.

Field Name: QW0142AC

TABLE NAME
The table name that is being created, altered, or dropped.

Field Name: QW0142TN

TABLE OWNER
The table owner (same as table qualifier).

Field Name: QW0142OW

TABLE OWNER TYPE
The table owner type. TABLE OWNER TYPE can have the following values:

- PRIMARY OR SECONDARY AUTH ID
- ROLE

Field Name: QW0142OR

TABLE CREATOR
The table creator.

Field Name: QW0142CR

OPTIONS
The options used in the host to check the SQL statement. The bits of this field are used as indicators. If all bits are 0, the statement is not an SQL statement. See the OPTIONS field of "IFCID140: Audit Authorization Failures" on page 1156 for a full description of the bits of this field.

Field Name: QW0142HO

DATABASE
The database ID.

Field Name: QW0142DB

TABLE OBID
The object ID.

Field Name: QW0142OB

SECLABEL OF MLS TABLE
The security label of the Multilevel Security (MLS) table.

Field Name: QW0142SL

MULTILEVEL SECURITY
Shows the multilevel security (MLS) status as follows:

- Y (on CREATE or DROP of an MLS Table, or ALTER to add a SECLABEL column)
- N (on ALTER of an MLS table)
- NON-MLS
- N/A

Field Name: QW0142ML

ROW/COLUMN ACCESS CONTROL
Shows the row and column access control status. The field can have one of the following values:

- ACTIVATE ROW ACCESS CONTROL
- ACTIVATE COLUMN ACCESS CONTROL
- ACTIVATE ROW AND COLUMN ACCESS CONTROL
- NO ACCESS CONTROL
- N/A

Field Name: QW0142RC

SQL STMT
The SQL statement text. Long SQL text can be truncated.

Field Name: QW0142TX

Example

```
AUDIT DDL
ALTER         TABLE NAME   : TBCCDB2A
              TABLE OWNER  : SCCCDB2A
              TABLE OWNER TYPE: N/A
              TABLE CREATOR: USRT001
              OPTIONS      : X'0400000000000000'
              DATABASE     : 00269
              TABLE OBID   : 00003
              SECLABEL OF MLS TABLE: L3C234
              MULTILEVEL SECURITY  : N (on ALTER of an MLS table)
              ROW/COLUMN ACCESS CONTROL: NO ACCESS CONTROL
              SQL STMT: ALTER TABLE SCCCDB2A.TBCCDB2A ALTER COLUMN NAME SET DATA TYPE VARCHAR(10)
```

PSPI

IFCID143: Audit First Write

The IFCID143 DD contains the extracted IFCID 143 (Audit First Write) records.

Fields

PSPI The IFCID143 DD has the following fields:

DATABASE
The database ID.

Field Name: QW0143DB

LOGRBA
The identifier of the unit of recovery.

Field Name: QW0143UR

PAGESET
The page set name or decimal identifier.

Field Name: QW0143PS

TABLE OBID
The object ID.

Field Name: QW0143OB

STATEMENT ID
The statement ID. This field can contain one of the following values:

- SQL statement ID
- 0

Field Name: QW0143SI

Example

```
DATABASE: 00269          LOGRBA    : X'0000000000001EE006FD'
PAGE SET: 00002          TABLE OBID: 00004
STATEMENT ID: 00000000000000036343
```

PSPI

IFCID144: Audit First Read

The IFCID144 DD contains the extracted IFCID 144 (Audit First Read) records.

Fields

PSPI The IFCID144 DD has the following fields:

DATABASE
The database ID.

Field Name: QW0144DB

LOGRBA
The identifier of the unit of recovery.

Field Name: QW0144UR

PAGESET
The page set name or decimal identifier.

Field Name: QW0144PS

TABLE OBID
The object ID.

Field Name: QW0144OB

STATEMENT ID
The statement ID. This field can contain one of the following values:

- SQL statement ID
- 0

Field Name: QW0144SI

Example

```
DATABASE: 00269          LOGRBA    : X'0000000000001EE006FD'
PAGE SET: 00002          TABLE OBID: 00004
STATEMENT ID: 00000000000000000000
```

PSPI

IFCID145: Audit DML Statement

The IFCID145 DD contains the extracted IFCID 145 (Audit DML Statement) records.

Fields

PSPI The IFCID145 DD has the following fields:

LOCATION NAME
The location name.

Field Name: QW0145LN

PKG COLLCT ID
The package collection identifier.

Field Name: QW0145PC

PROGRAM NAME
The program name.

Field Name: QW0145PN

TIME The hexadecimal value of the precompiler timestamp.

Field Name: QW0145TS

TYPE The SQL statement type.

Field Name: QW0145ST

STMT#
The precompiler statement number.

Field Name: QW0145SN

STATEMENT ID
The statement ID. This field can contain one of the following values:

- SQL statement ID
- 0

Field Name: QW0145SI

HOST OPTIONS
The options used in the host to check the SQL statement. The bits of this field are used as indicators. If all bits are 0, the statement is not an SQL statement. See the OPTIONS field of "IFCID140: Audit Authorization Failures" on page 1156 for a full description of the bits of this field.

Field Name: QW0145HO

SQL TEXT
The SQL statement text.

Field Name: QW0145RT_Var

DATABASE
The database ID.

Field Name: QW0145DB

TABLE OBID
The object ID.

Field Name: QW0145OB

ISOLATION
The isolation level of the DML statement. ISOLATION can have the following values:

- RR Repeatable read
- CS Cursor stability
- RS Read stability
- UR Uncommitted read

- RRX Repeatable read with X lock
- RSX Read stability with X lock

Field Name: QW0145IS

ACCESS SCHEMA

Field Name: QW0145AS_D

ACCESS OBJECT

The access control object name

Field Name: QW0145AO_D

Example

```
LOCATION NAME: STLEC1
PKG COLLCT ID: PKCC1A3
PROGRAM NAME : MCC1A3
TIME         : 02:22:12
TYPE         : INSERT                       STMT#: 0000000014
STATEMENT ID : 00000000000000036343
HOST OPTIONS : X'0300D70010020000'
DATABASE     : 00269                  TABLE OBID: 00004
ISOLATION    : CS
SQL TEXT:  INSERT INTO SCCC1A31 . TBCC1A31 ( ID , NAME ) VALUES ( 1 , 'X' )
```

PSPI

IFCID269: Trusted Connection

The IFCID269 DD contains the extracted IFCID 269 (Trusted Connection) records.

Fields

PSPI The IFCID269 DD has the following fields:

CONNECTION TYPE

The type of trusted connection. CONNECTION TYPE can have the following values:

- ESTABLISHED
- REUSED

Field Name: QW0269TY

STATUS

The status of the trusted connection. This value indicates a success if a trusted connection was established or reused successfully. It indicates a failure if a trusted connection failed when it was tried to be established or reused. STATUS can have the following values:

- FAILED
- SUCCESS

Field Name: QW0269ST

SQLCODE

The SQLCODE that is returned after running the SQL statement.

Field Name: QW0269SQ

TRUSTED CONTEXT NAME

The trusted context name.

Field Name: QW0269TC

SYSTEM AUTHID USED
The system authorization ID that is used to establish the trusted connection.

Field Name: QW0269SA

ROLE ASSOCIATED
The default role that is associated with the context.

Field Name: QW0269RC

OBJECT OWNER
The owner of the objects that are created using the trusted context. This value indicates whether a ROLE or an AUTHORIZATION ID created the objects. OBJECT OWNER can have the following values:

- AUTHID
- ROLE

Field Name: QW0269OT

SECURITY LABEL
The security label.

Field Name: QW0269SL

TCP/IP ADDRESS
The communication TCP/IP address that is used for connection.

Field Name: QW0269AD

SERVAUTH NAME
The SERVAUTH name of the TCP/IP security zone.

Field Name: QW0269SR

ENCRYPTION
The encryption value that is to be associated with the encryption trust attribute for a trusted context.

Field Name: QW0269EC

JOB NAME
The job name for a local application.

Field Name: QW0269JN

REUSE AUTHID
The authorization ID under which a trusted connection is reused.

Field Name: QW0269RA

USER ROLE
The user role.

Field Name: QW0269RU

PROFILE NAME
The profile name.

Field Name: QW0269PR

Example

```
CONNECTION TYPE     : ESTABLISHED
STATUS              : SUCCESS          SQLCODE:  0000000000
TRUSTED CONTEXT NAME: CTXCC1A33
SYSTEM AUTHID USED  : USRT003
```

```
ROLE ASSOCIATED     : ROLECC1A3_SYSADM
OBJECT OWNER        : ROLE
SECURITY LABEL      : ........
TCP/IP ADDRESS      : 9.30.89.162
SERVAUTH NAME       :
ENCRYPTION          : NONE
JOB NAME            :
REUSE AUTHID        :
USER ROLE           : ROLECC1A3_SYSADM
PROFILE NAME        :
```

PSPI

IFCID270: Trusted Context

The IFCID270 DD contains the extracted IFCID 270 (Trusted Context) records.

Fields

PSPI The IFCID270 DD has the following fields:

STATEMENT TYPE
The type of trusted context. STATEMENT TYPE can have the following values:

- ALTER
- CREATE

Field Name: QW0270TY

SQLCODE
The SQL return code from the CREATE or ALTER TRUSTED CONTEXT statement.

Field Name: QW0270SQ

SQL STMT LENGTH
The length of the SQL statement.

Field Name: QW0270SL

SQL STATEMENT
The SQL statement.

Field Name: QW0270SS

Example

```
STATEMENT TYPE : CREATE
SQLCODE        :  0000000000
SQL STMT LENGTH:  0000000236
SQL STATEMENT  : CREATE TRUSTED CONTEXT CTXCC1A33 BASED UPON CONNECTION USING SYSTEM AUTHID USRT003 ATTRIBUTES(ADDRESS '9.30.89
                 .162') DEFAULT ROLE ROLECC1A3_SYSADM WITH ROLE AS OBJECT OWNER AND QUALIFIER ENABLE WITH USE FOR USRT003 ROLE
                 ROLECC1A3_SYSADM
```

PSPI

IFCID350: SQL Statement

The IFCID350 DD contains the extracted IFCID 350 (SQL Statement) records.

Fields

PSPI The IFCID350 DD has the following fields:

OPTIONS
Shows the parser options and host language.

Field Name: QW0350OT

HOST LANG
Shows the host language. HOST LANG can have the following values:

- ASSEMBLER
- COBOL
- C
- FORTRAN
- PL/I
- COBOL II
- IBM COBOL
- C++
- N/A

Field Name: QW0350HL

SOURCE CCSID

Field Name: QW0350CC

SQL SEGMENT
Shows a segment of the SQL statement. SQL SEGMENT can have the following values:

FIRST The first segment of the SQL statement.

LAST The last segment of the SQL statement.

COMPLETE
The entire SQL statement.

OTHER
Some other segment of the SQL statement.

Field Name: QW0350FG

SQL LENGTH
The total length of the SQL statement.

Field Name: QW0350TL

SQL STATEMENT
Shows the complete SQL statement that is being parsed or only a part of it. Note: Host variables in this field are represented by `:h.`.

Field Name: QW0350SP

SQL STATEMENT ID

Field Name: QW0350SI

SQL STATEMENT TYPE

Field Name: QW0350TY

Example

```
OPTIONS      : X'04'             HOST LANG : N/A
SQL STATEMENT TYPE: DYNAMIC
SQL STATEMENT ID  : 00000000000000000000
SOURCE CCSID      : 00037
SQL SEGMENT  : FIRST             SQL LENGTH: 0000117158
SQL STATEMENT: INSERT INTO CCC501TAB ⌂
```

PSPI

IFCID361: Audit Administrative Authorities

The IFCID361 DD contains the extracted IFCID 361 (Audit Administrative Authorities) records.

Fields

PSPI The IFCID361 DD has the following fields:

AUTHORITY TYPE
The type of administrative authority.

ROLE or AUTHID
The label that indicates the type of authorization followed by the role or authid that has the authority

Field Name: QW0361IT and QW0361ID_Var

PRIVILEGE CHECKED
The privilege that is checked. PRIVILEGE CHECKED can have the following values:

- ALL ON PACKAGES
- ALLPKAUT
- ALTER
- ALTER BUFFERPOOL
- ALTER INDEX
- ALTERIN
- ARCHIVE
- BIND ADD
- BIND, REBIND OR FREE
- BINDAGENT
- CHECK DATA UTILITY
- CHECK UTILITY
- COMMENT ON
- COMMENT ON INDEX
- COPY
- COPY PACKAGE
- CREATE ALIAS
- CREATE GLOBAL TEMPORARY TABLE (CREATETMTAB)
- CREATE IN
- CREATE INDEX
- CREATE SECURE OBJECT
- CREATE STOGROUP

- CREATE SYNONYM
- CREATE TABLE
- CREATE TABLESPACE
- CREATE VIEW
- CREATEDBA
- CREATEDBC
- CREATEIN
- DBADM
- DBCTRL
- DBMAINT
- DDF COMMAND - START, STOP, OR CANCEL
- DEBUG SESSION
- DELETE
- DESCRIBE TABLE
- DIAGNOSE UTILITY
- DISPLAY
- DISPLAY ARCHIVE
- DISPLAY BUFFERPOOL
- DISPLAY DATABASE
- DISPLAY PROFILE
- DISPLAY RLIMIT
- DISPLAY THREAD OR DISPLAY DB
- DISPLAY UTILITY
- DROP
- DROP ALIAS
- DROP INDEX
- DROP SYNONYM
- DROPIN
- EXECUTE
- EXPLAIN
- EXPLAIN MONITOR
- EXPLICIT QUALIFIER USE
- INSERT
- LOAD
- LOCK TABLE
- MERGECOPY UTILITY
- MLS READWRITE
- MODIFY UTILITY
- MONITOR1
- MONITOR2
- OTHER
- PACKADM
- QUERY TUNING
- QUIESCE UTILITY
- READ

- RECOVER (UTILITY)
- RECOVER BSDS
- RECOVER INDOUBT
- REFERENCES
- RENAME INDEX
- RENAME TABLE
- REORG
- REPAIR
- REPAIR DBD UTILITY
- REPORT UTILITY
- RUNSTATS UTILITY
- SECADM
- SELECT
- SET ARCHIVE
- SQLADM
- START
- START DATABASE
- START DB2, STOP DB2, START DB(*) OR STOP DB(*)
- START PROFILE
- START RLIMIT
- STOP
- STOP DATABASE
- STOP OR START TRACE
- STOP PROFILE
- STOP RLIMIT
- STOSPACE UTILITY
- SUBPKAUT
- SYSADM
- SYSCTRL
- SYSOPR
- SYSOPR SYSCTRL SYSADM SECADM
- TERM UTILITY
- TERMINATE UTILITY ON DATABASE
- TRIGGER
- UPDATE
- USAGE
- USE
- VALIDATE SECLABEL
- WRITE

Field Name: QW0361PR

SOURCE QUALIFIER
The source qualifier.

Field Name: QW0361SC_Var

SOURCE OBJECT
The source object name or original subsystem parameter value.

Field Name: QW0361SN_Var

TARGET QUALIFIER
The target qualifier.

Field Name: QW0361TC_Var

TARGET OBJECT
The target object name or modified z-parm value.

Field Name: QW0361TN_Var

OBJECT TYPE
The object type. OBJECT TYPE can have the following values:

- ACEE
- APPLICATION PLAN
- BUFFERPOOL
- COLLECTION
- DATABASE
- DISTINCT TYPE
- FUNCTION
- SESSION VARIABLE
- JAR
- PACKAGE
- PROCEDURE
- ROLE
- ROW
- SCHEMA
- SEQUENCE
- STORAGE GROUP
- TABLE OR VIEW
- TABLESPACE
- TRUSTED CONTEXT
- USER AUTH (System privileges, such as SYSADM or SYSOPR)
- N/A

Field Name: QW0361OT

OTHER OBJECT
The other object name or subsystem parameter value.

Field Name: QW0361ON_Var

SQL LENGTH
The length of the SQL statement.

Field Name: QW0361LL

SQL STATEMENT
The SQL statement (truncated at 4000 max) .

Field Name: QW0361SQ

Example

```
AUTHORITY TYPE   : U
AUTHID           : USER000
PRIVILEGE CHECKED: STOP OR START TRACE
OBJECT TYPE      : USER AUTH
SQL LENGTH       : 0000000022
SQL STATEMENT    : -STOP TRACE(AUDIT)
```

PSPI

IFCID362: Trace Start and Stop with AUDITPOLICY

The IFCID362 DD contains the extracted IFCID 362 (Trace Start and Stop with AUDITPOLICY) reacords.

Fields

PSPI The IFCID362 DD has the following fields:

STATUS
The status of the trusted connection. This indicates a success if a trusted connection was established or reused successfully. It indicates a failure if a trusted connection failed when it was tried to be established or reused.

Field Name: QW0362ST

TYPE The type

Field Name: QW0362TY

REASON CODE
The reason code.

Field Name: QW0362RN

CHECKING CATEGORY
The category CHECKING.

Field Name: QW0362CH

VALIDATE CATEGORY
The category VALIDATE.

Field Name: QW0362VA

OBJMAINT CATEGORY
The category OBJMAINT.

Field Name: QW0362OB

EXECUTE CATEGORY
The category EXECUTE.

Field Name: QW0362EX

CONTEXT CATEGORY
The category CONTEXT.

Field Name: QW0362CX

SECMAINT CATEGORY
The category SECMAINT.

Field Name: QW0362SM

DB2 START
DB2 startup.

Field Name: QW0362DS

DATABASE NAME
The Database name.

Field Name: QW0362DB

OBJECT TYPE
The object type.

Field Name: QW0362OT

AUDIT POLICY NAME
The audit policy name.

Field Name: QW0362AP_Var

TABLE SCHEMA NAME
The table schema name.

Field Name: QW0362TS_Var

TABLE NAME
The table name.

Field Name: QW0362TB_Var

SYSADMIN CATEGORY
The SYSADM categories.

Field Name: QW0362SA_Var

DBADMIN CATEGORY
The DBADM categories.

Field Name: QW0362DA_Var

COLLECTION ID
The collection ID.

Field Name: QW0362CO_Var

LIKE TABLES
The total number of tables that match the LIKE clause.

Field Name: QW0362TT

LIKE TABLES TRACED
The number of LIKE tables that are traced.

Field Name: QW0362TR

LIKE TABLE #
The name of the LIKE table that is traced.

Field Name: QW0362TN

Example

```
STATUS            : SUCCESS
TYPE              : START TRACE
REASON CODE       :  0000000000
CHECKING CATEGORY :
VALIDATE CATEGORY : A
OBJMAINT CATEGORY :
EXECUTE CATEGORY  :
```

```
CONTEXT CATEGORY  :
SECMAINT CATEGORY :
DB2 START         :
DATABASE NAME     :
OBJECT TYPE       : ALL SUPPORTED
AUDIT POLICY NAME : VLDPLCY
LIKE TABLES       : 00000
LIKE TABLES TRACED: 00000
```

PSPI

SYSPRINT: Runtime messages and end-of-job summary

The SYSPRINT DD contains any warning and error messages that were generated during processing, plus a breakdown of the records that were read and processed.

Example

PSPI

```
DSN1SMFP - End of job summary

                                                Read                  Written
                                          ----------------------  ----------------------
Total records:............................        33                     31
  SMF Type 101 records:......................       0                      0
    Type 101 from DB2 Version 11:...........       0
      IFCID 003 for distributed data:...           0                      0
      Other IFCID 003:..................           0
      Other Type 101 IFCIDs:............           0
    Type 101 from other DB2 releases:.......       0

  SMF Type 102 records:......................      31                     31
    Type 102 from DB2 Version 11:...........      31
      IFCID 004:........................           2                      2
      IFCID 005:........................           2                      2
      IFCID 023:........................           0                      0
      IFCID 024:........................           0                      0
      IFCID 025:........................           0                      0
      IFCID 083:........................           0                      0
      IFCID 106:........................           0                      0
      IFCID 140:........................           0                      0
      IFCID 141:........................           0                      0
      IFCID 142:........................           0                      0
      IFCID 143:........................           0                      0
      IFCID 144:........................           0                      0
      IFCID 145:........................          12                     12
      IFCID 269:........................           0                      0
      IFCID 270:........................           0                      0
      IFCID 350:........................          15                     15
      IFCID 361:........................           0                      0
      IFCID 362:........................           0                      0
      Other Type 102 IFCIDs:............           0
    Type 102 from other DB2 releases:.......       0

  Other SMF records:.............................   2

  Invalid IFCID Records:........................   0
```

Attention: This figure indicates the number of input records that were counted under a particular IFCID type but that were subsequently rejected because subsequent processing has revealed problems such as missing sections. The Invalid IFCID Records count, therefore, is not part of the Total Records Read count.

PSPI

Appendix F. DSNADMSB

The DSNADMSB program collects information about a DB2 subsystem and its objects and applications.

The output from DSNADMSB is primarily for the use of IBM Software Support. The output might change at any time.

IBM Software Support can use the information that DSNADMSB gathers to duplicate a customer environment to diagnose and resolve problems. This capability is especially useful for re-creating performance problems.

Output

Output from the DSNADMSB program consists of files that contain one or more of the following items:

- Data definition statements for re-creating user objects
- Statistics from the DB2 catalog
- INSERT statements for inserting rows into tables:
  - DSN_PROFILE_ATTRIBUTES
  - DSN_PROFILE_TABLE
  - PLAN_TABLE
  - SYSACCELERATEDTABLES
  - SYSACCELERATORS
- Output from:
  - DSN_DETCOST_TABLE
  - DSN_PREDICAT_TABLE
  - DSN_PROFILE_TABLE
  - DSN_PROFILE_ATTRIBUTES
  - PLAN_TABLE
  - SYSACCELERATEDTABLES
  - SYSACCELERATORS
- Subsystem parameter settings and module entry point list (MEPL) information
- Module entry point list (MEPL) information that relates to query processing
- Status information from stored procedure ADMIN_INFO_SQL

Authorization required

To execute DSNADMSB, you must have the following DB2 privileges or authorities:

- EXECUTE authority on plan DSNADMSB
- One of the following privileges or authorities:
  - The EXECUTE privilege on the ADMIN_INFO_SQL stored procedure
  - Ownership of the ADMIN_INFO_SQL stored procedure
  - SYSADM authority

In addition, if you direct DSNADMSB to write its output to data sets, you need to be authorized to perform either of the following tasks:

- Create data sets
- Write to already existing data sets

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Parameters of the DSNADMSB program

The parameters of the DSNADMSB program determine the types of information that the program gathers, and the destination to which the information is written.

The output from DSNADMSB is primarily for the use of IBM Software Support. The output might change at any time.

All parameters are positional and required, and no parameter value can be NULL. Specify parameters in a data set that is associated with the INPUTP DD statement, with one parameter value in each record. A single parameter can span multiple records. Indicate continuation of the text for a parameter with a plus sign (+) in column one of all records after the first one. DSNADMSB trims blanks at the end of all lines. DSNADMSB does not trim blanks within the parameter text.

Parameter descriptions

table-creator
The qualifier for the table, table list table (LIST_TABLE-*list-table*), or PLAN_TABLE for which DSNADMSB gathers information. The maximum length of *table-creator* is 128 bytes. *table-creator* cannot be null.

table-name
One of the following values:

- The name of a single user object that has *table-creator* as its qualifier. The name must identify one of the following types of objects:
  - Base table
  - View
  - Alias
  - Clone table
  - Created temporary table
  - History table
  - Materialized query table
  - Implicitly created table for an XML column
- LIST_TABLE-*list-table*

  list-table identifies a DB2 table on the local subsystem that has *table-creator* as the qualifier. The table must contain two columns, named CREATOR and TABLE. Each row of *list-table* identifies a table or view for which DSNADMSB is to gather information. The types of tables that are specified in LIST_TABLE-*list-table* are the same as the types of tables that can be specified by *table-name*.
- PLAN_TABLE

  Specifies that DSNADMSB uses *table-creator*.PLAN_TABLE and the *plan-info* parameter to determine the tables about which information is gathered. The referenced PLAN_TABLE must be a base table.

  Recommendation: When you specify PLAN_TABLE, ensure that the view reference table, DSN_VIEWREF_TABLE, exists before you execute EXPLAIN. The existence of DSN_VIEWREF_TABLE is especially important if the queries about which you are collecting information contain views. If DSN_VIEWREF_TABLE exists and has been populated by EXPLAIN, you can use DSNADMSB to collect view data that is specific to the queries of interest, instead of collecting data on all view dependencies. The

DSN_VIEWREF_TABLE must have the same qualifier as the plan table. This qualifier is the first DSNADMSB input parameter, *table-creator*.

The maximum length of *table-name* is 128 bytes.

If the table name is a delimited identifier, do not include the delimiters in *table-name*.

catalog-creator
The qualifier for the DB2 catalog, or DEFAULT, which indicates that the catalog qualifier is SYSIBM.

The maximum length of *catalog-creator* is 128 bytes.

plan-info
If the table that is specified by *table-name* is PLAN_TABLE, *plan-info* is a value of the following form, or NONE:

```
program-begin-queryno-end-queryno
```

The meanings of these variables are:

program
A value from the PROGNAME column of the PLAN_TABLE, or a pattern that specifies a set of PROGNAME values in the PLAN_TABLE. Any pattern that is valid in a LIKE predicate can be specified. *program* represents programs or packages for which DSNADMSB collects PLAN_TABLE information.

begin-queryno
A value from the QUERYNO column of the PLAN_TABLE. The value represents the lowest statement number for which DSNADMSB collects PLAN_TABLE information.

end-queryno
A value from the QUERYNO column of the PLAN_TABLE. The value represents the highest statement number for which DSNADMSB collects PLAN_TABLE information.

If *table-name* does not specify PLAN_TABLE, the *plan-info* value must be NONE.

The maximum length of *plan-info* is 150 bytes.

collect-ddl
Specifies whether DSNADMSB returns the data definition language statements that were used to create the input tables or views that are specified by *table-name*, and data definition language statements for related objects. The length of *collect-ddl* is 1 byte.

When the input table is not PLAN_TABLE, possible values are:

N Do not return the data definition language statements that created the objects.

Y Return the data definition language statements that created:
- The input objects
- Foreign keys that reference the input objects
- Views on the input objects

0 Return the data definition language statements that created:
- The input objects. Statements that create views on the input objects or foreign keys that reference the input objects are not collected.

1 Return the data definition language statements that created:

- The input objects
- Views on the input objects

2 Return the data definition language statements that created:

- The input objects
- Foreign keys that reference the input objects

3 Return the data definition language statements that created:

- The input objects
- Foreign keys that reference the input objects
- Views on the input objects
- Other objects that depend on the input objects, such as materialized query tables

This option can result in a large amount of data. Do not use this option for data collection that is requested by IBM Software Support.

4 Return the same data definition language statements that are returned when option Y is specified.

When the input table is PLAN_TABLE, possible values are:

N Do not return the data definition language statements that created the objects.

Y Return the data definition language statements that created:

- The objects that are identified by *plan-info*
- Foreign keys that reference the objects that are identified by *plan-info*
- If DSN_VIEWREF_TABLE exists and is populated, views or materialized query tables that are used to process the queries that are identified by *plan-info*.
- If DSN_VIEWREF_TABLE does not exist, views on objects that are identified by *plan-info*. DSNADMSB requires more time to gather data if DSN_VIEWREF_TABLE is not available than if DSN_VIEWREF_TABLE is available.

0 Return the data definition language statements that created:

- The objects that are identified by *plan-info* only. Statements that create views on the objects or foreign keys that reference the objects that are identified by *plan-info* are not collected.

1 Return the data definition language statements that created:

- The objects that are identified by *plan-info*
- If DSN_VIEWREF_TABLE exists and is populated, views or materialized query tables that are used to process the queries that are identified by *plan-info*.
- If DSN_VIEWREF_TABLE does not exist, views on objects that are identified by *plan-info*. DSNADMSB requires more time to gather data if DSN_VIEWREF_TABLE is not available than if DSN_VIEWREF_TABLE is available.

2 Return the data definition language statements that created:

- Foreign keys that reference the objects that are identified by *plan-info*

3 Return the data definition language statements that created:

- The objects that are identified by *plan-info*

- Foreign keys that reference the objects that are identified by *plan-info*
- Views on objects that are identified by *plan-info*
- Other objects that depend on the objects that are identified by *plan-info*, such as materialized query tables

This option can result in a large amount of data. Do no specify this option for problem analysis by IBM Software Support unless they direct you to do so.

4 Return the data definition language statements that created:

- The objects that are identified by *plan-info*
- Foreign keys that reference the objects that are identified by *plan-info*
- Views on objects that are identified by *plan-info*

This option does not use information from DSN_VIEWREF_TABLE. DSNADMSB requires more time to gather data if you choose option 4 than if you choose option Y, and DSN_VIEWREF_TABLE is available.

collect-stats

Specifies whether DSNADMSB returns statistical information from DB2 catalog tables about the tables that are specified by *table-name* and related objects. Possible values are:

Y Return statistical information about tables from the DB2 catalog.

N Do not return statistical information about tables from the DB2 catalog.

Important: Setting a *collect-stats* value of Y might generate large amounts of data. Set *collect-stats* to N unless you specifically need statistical information from DB2 catalog tables.

The length of *collect-stats* is 1 byte.

collect-colstats

Specifies whether DSNADMSB returns statistical information from DB2 catalog tables about the columns in tables that are specified by *table-name* and related objects. Possible values are:

Y Return statistical information about columns from the DB2 catalog.

N Do not return statistical information about columns from the DB2 catalog.

Important: Setting a *collect-colstats* value of Y might generate large amounts of data. Set *collect-colstats* to N unless you specifically need statistical information from DB2 catalog tables.

The length of *collect-colstats* is 1 byte.

edit-ddl

Specifies whether DSNADMSB modifies the data definition language statements that it generates so that the data definition language statements can be more easily executed by IBM Software Support. Examples of changes that DSNADMSB makes are:

- Setting the STOGROUP to SYSDEFLT
- Setting PRIQTY and SECQTY to their minimum values
- Setting DEFINE to NO
- Commenting out foreign key definitions

Possible values are:

Y Edit the data definition language statements that DSNADMSB produces.

Y is the recommended value if you do not send data to populate the tables that are specified by *table-name* to IBM Software Support.

N Do not edit the data definition language statements that DSNADMSB produces.

The length of *edit-ddl* is 1 byte.

edit-version-mode
Specifies that the output should be formatted for a different version and mode of DB2 for z/OS than the version and mode that is currently running when collecting information. You must specify the version number and the mode, or you can specify NONE so that the output is not converted to another format.

Valid values for mode are `C` for conversion mode and `N` for new-function mode. For example, if your DB2 subsystem is running in Version 10 conversion mode, and you want to generate the output for Version 9 new-function mode, specify `9-N`.

This is an input parameter of type CHAR(4) and cannot be null.

partition-rotation
Specifies whether DSNADMSB checks the amount of rotation that a partitioned table has undergone. DSNADMSB determines the number of partition rotations that are needed to synchronize logical partitions with physical partitions. Possible values are:

Y Check for the amount of partition rotation.

Y is valid only for partitioned tables.

N Do not check for the amount of partition rotation.

The length of *partition-rotation* is 1 byte.

output-method
Specifies the type of destination for DSNADMSB output. Possible values are:

R Output is returned in the job stream. In most cases, R should be used.

Q Output is returned in data sets that DSNADMSB creates. You supply the qualifier name and primary and secondary allocation quantities for those data sets in the *output-info* parameter.

Important: The data sets are temporary data sets that are created on scratch packs. Depending on how the z/OS system is configured, the data sets might be deleted after a short time.

N Output is returned in existing data sets that are allocated by the WLM environment startup procedure. You supply the data set names in the *output-info* parameter.

D Output is returned in data sets that DSNADMSB creates. You supply the data set names and primary and secondary allocation quantities for those data sets in the *output-info* parameter.

The length of *output-method* is 1 byte.

output-info
Specifies output data set information. The information depends on the value of *output-method*:

output-method **value**	*output-info* **value**
R	NONE
Q	A string of this form: *qualifier-primary-secondary* *qualifier* A string of up to 29 bytes, or DEFAULT. DSNADMSB appends a string that defines the type of output data set. If *qualifier* is not DEFAULT, *qualifier* must conform to the rules for z/OS data set names. If *qualifier* is DEFAULT, DSNADMSB generates a *qualifier* value of the following form: PM*nnnnn*.D*yymmdd*.T*hhmmss* *nnnnn* is the PMR number. *yymmdd* and *hhmmss* are the date and time when DSNADMSB ran. The strings that DSNADMSB appends to *qualifier* are: • .DDL for the data set that contains data definition statements for user tables or the PLAN_TABLE • .SQL for the data set that contains SQL statements that populate PLAN_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS • .STATS for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about tables • .COLST for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about columns • .EXPL for the data set that contains output from tables PLAN_TABLE, DSN_PREDICAT_TABLE, DSN_DETCOST_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS • .PARM for the data set that contains subsystem parameter settings *primary* The primary allocation quantity for the output data sets, or DEFLT. If you specify DEFLT, the primary allocation quantity is 200 tracks. *secondary* The secondary allocation quantity for the output data sets, or DEFLT. If you specify DEFLT, the secondary allocation quantity is 200 tracks.
N	A string of this form: *ddldd-sqldd-statsdd-colstdd-colstdd-parmdd* Each part of the string is the DD name for a data set that is defined in the WLM startup procedure for the WLM environment in which the ADMIN_INFO_SQL stored procedure runs. The DD names are: • *ddldd* for the data set that contains data definition statements for user tables or the PLAN_TABLE • *sqldd* for the data set that contains SQL statements that populate PLAN_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS • *statsdd* for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about tables • *colstdd* for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about columns • *expldd* for the data set that contains output from tables PLAN_TABLE, DSN_PREDICAT_TABLE, DSN_DETCOST_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS • *parmdd* for the data set that contains subsystem parameter settings

output-method **value**	*output-info* **value**

D	A string of this form:
	`DDL;dsname;volser;allocunits;primary;secondary-`
	`SQL;dsname;volser;allocunits;primary;secondary-`
	`STATS;dsname;volser;allocunits;primary;secondary-`
	`COLST;dsname;volser;allocunits;primary;secondary-`
	`EXPL;dsname;volser;allocunits;primary;secondary-`
	`PARM;dsname;volser;allocunits;primary;secondary`
	
	The meanings of the items in the string are:
	
	DDL, SQL, STATS, COLST, EXPL, PARM
	Identifies the type of output that DSNADMSB puts in the data set:
	• DDL for the data set that contains data definition statements for user tables or the PLAN_TABLE
	• SQL for the data set that contains SQL statements that populate PLAN_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS
	• STATS for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about tables
	• COLST for the data set that contains SQL statements that populate DB2 catalog tables with statistical information about columns
	• EXPL for the data set that contains output from tables PLAN_TABLE, DSN_PREDICAT_TABLE, DSN_DETCOST_TABLE, DSN_PROFILE_TABLE, DSN_PROFILE_ATTRIBUTES, and SYSACCELERATORS
	• PARM for the data set that contains subsystem parameter settings
	
	dsname The fully qualified name of the data set that DSNADMSB allocates, or DEFAULT. If you specify DEFAULT, the data set names have this form:
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.COLST`
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.DDL`
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.EXPL`
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.PARM`
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.SQL`
	`PMnnnnn.Dyymmdd.Thhmmss.Vn.STATS`
	
	nnnnn is the PMR number, without the branch code or country code.
	
	yymmdd is the date and *hhmmss* is the time when DSNADMSB ran.
	
	n is a release indicator.
	
	volser The volume serial on which the data set is created.
	
	allocunits
	Valid values are TRK or CYL.
	
	primary The primary allocation quantity for the output data set.
	
	secondary
	The secondary allocation quantity for the output data set.

The maximum length of *output-info* is 1024 bytes.

pmr-info
The number of the PMR for which the data is being collected, in this form:
number.branch-code.country-code

PSPI

Related reference:

"Examples of DSNADMSB invocation" on page 1189
"Data sets that DSNADMSB uses"

PLAN_TABLE (DB2 Performance)

Before running DSNADMSB

Certain activities might be required before you run the DSNADMSB program.

Before you run DSNADMSB, perform the following actions:

- Check that the SYSPROC.ADMIN_INFO_SQL stored procedure that is supplied by DB2 is installed. In general, this activity is performed during the installation process.

  Installation job DSNTIJRT installs all DB2-supplied routines and sets up the WLM environments for them.
- Check that the plan for DSNADMSB is bound. In general, this activity is performed during the installation process. Installation job DSNTIJSG binds the package and plan for DSNADMSB.
- Ensure that enough space is available for the output. DSNADMSB might generate large amounts of data. The average is 2 - 3 MB of space, but larger workloads might generate up to 20 MB of data.
- Prepare a job for running DSNADMSB. The easiest way to do that is to customize a copy of sample job DSNTEJ6I, which is in data set *prefix*.SDSNSAMP. The job prolog has detailed instructions on how to customize the job.
-

  Recommendation: If you are running DSNADMSB to collect information from the plan table, PLAN_TABLE, ensure that the view reference table, DSN_VIEWREF_TABLE, also exists before you execute EXPLAIN. The existence of DSN_VIEWREF_TABLE is especially important if the queries about which you are collecting information contain views. If DSN_VIEWREF_TABLE exists and has been populated by EXPLAIN, you can use DSNADMSB to collect view data that is specific to the queries of interest, instead of collecting data on all view dependencies. The DSN_VIEWREF_TABLE must have the same qualifier as the plan table. This qualifier is the first DSNADMSB input parameter, *table-creator*.

Related concepts:

Job DSNTIJRT (DB2 Installation and Migration)

Related reference:

"Data sets that DSNADMSB uses"

"Parameters of the DSNADMSB program" on page 1180

Job DSNTIJSG (DB2 Installation and Migration)

ADMIN_INFO_SQL stored procedure (DB2 Administration Guide)

DSN_VIEWREF_TABLE (DB2 Performance)

Data sets that DSNADMSB uses

The DSNADMSB utility uses a number of data sets during its operation.

DSNADMSB runs under the DSN DB2 command processor. The following table lists the data sets that DSNADMSB uses, in addition to the standard data sets that are required for running an application under DSN.

Table 171. Data sets that DSNADMSB uses

Data set type	DD name	Description	Required?
Input	INPUTP	Contains the DSNADMSB parameters. The INPUTP data set must have a logical record length of 80. Only bytes 1 through 71 can contain input data.	Yes
Output	None	Up to six data sets that contain the diagnostic data that DSNADMSB generates. The data set names and characteristics are determined by the values that you specify for the *output-method* and *output-info* input parameter values.	Yes

Copying the data that DSNADMSB and ADMIN_INFO_SQL collect to another subsystem

The jobs that DSNADMSB and ADMIN_INFO_SQL produce are primarily intended for the use of IBM Software Support. However, you can modify those jobs so that you can run them on your own test systems to reproduce a problem environment.

Procedure

1. Ensure that your test system does not contain data that conflicts with the data that DSNADMSB or ADMIN_INFO_SQL collects.

   Recommendation: Use a newly installed DB2 subsystem for testing.
2. Customize the jobs:
   a. Modify the JOB statement for your test system.
   b. Change the subsystem name to the subsystem name for your test system.
   c. Change the steps that run TSOBATCH so that they run IKJEFT01. For example, suppose that the original code looks like this:

      ```
      //SETUP    EXEC TSOBATCH,DB2LEV=DB2A
      ```

      You need to change the code to something like this:

      ```
      //SETUP EXEC PGM=IKJEFT01,DYNAMNBR=20
      //SYSTSPRT DD  SYSOUT=*
      //SYSPRINT DD  SYSOUT=*
      //SYSUDUMP DD  SYSOUT=*
      //SYSTSIN  DD  *
      ```

   d. Change the steps that run DSNTEP3 so that they run DSNTEP2. For example, suppose that the original code looks like this:

      ```
      //SYSTSIN DD *
       DSN S(SSTR) R(1) T(1)
       RUN PROGRAM(DSNTEP3)
       END
      ```

      You need to change the code to something like this:

```
//SYSTSIN DD *
 DSN S(SSTR) R(1) T(1)
 RUN  PROGRAM(DSNTEP2) PLAN(DSNTEPB1) +
     LIB('DSNB10.RUNLIB.LOAD')
 END
```

3. Set the subsystem parameters on the test system as indicated in the output file that contains subsystem parameter values (PARM file).

   If DSNADMSB or ADMIN_INFO_SQL output is returned in a single job stream (*output-method* is R), the subsystem parameter output is at the end of the job output.

4. In the data definition language job (the job that contains `** DDL Information **`), make these changes:
   a. Modify the -ALTER BUFFERPOOL statements at the end of the job to contain settings that are appropriate for your test system.
   b. Remove the asterisks (**) in front of the -ALTER BUFFERPOOL statements.
   c. Move the -ALTER BUFFERPOOL statements to the place in the job that says:

      ```
      **BUFFERPOOL INFORMATION GOES HERE
      ```

5. Run the remainder of the jobs, in the following order:
   a. Data definition language job (contains `** DDL Information **`)
   b. Statistics INSERTs job (contains `** Stats inserts **`)
   c. Column statistics INSERTs job (contains `** Column Stats inserts **`)
   d. Plan, profile and accelerator INSERTs job (contains `** Plan, Profile and Accelerator Inserts **`)

Examples of DSNADMSB invocation

Use the DSNADMSB invocation examples as models for generating your own DSNADMSB output.

Example: Collecting data from a PLAN_TABLE

Suppose that you want DSNADMSB to retrieve data from plan table SYSADM.PLAN_TABLE rows for which PROGNAME is APROGRAM and 1<=QUERYNO<=12345. You want DSNADMSB to create the output in data sets whose names and characteristics you specify. The parameter values that you specify are:

Parameter	Value	Explanation
table-creator	SYSADM	These two parameters direct DSNADMSB to collect data from SYSADM.PLAN_TABLE.
table-name	PLAN_TABLE	
catalog-creator	DEFAULT	For catalog queries, directs DSNADMSB to use the default catalog table qualifier of SYSIBM.
plan-info	APROGRAM-1-12345	Directs DSNADMSB to collect data only for rows for which PROGNAME is 'APROGRAM' and QUERYNO is between 1 and 12345, inclusive.

Parameter	Value	Explanation
collect-ddl	Y	Directs DSNADMSB to collect the data definition statements that created SYSADM.PLAN_TABLE and associated objects.
collect-stats	Y	Directs DSNADBMSB to collect statistics about tables from the DB2 catalog.
collect-colstats	N	Directs DSNADBMSB not to collect statistics about table columns from the DB2 catalog.
edit-ddl	Y	Directs DSNADMSB to modify the data definition language statements that it generates so that the data definition language statements can be more easily executed by IBM Software Support.
edit-version-mode	NONE	Directs DSNADMSB not to modify its output to run on a different DB2 version from the version for which the data was collected.
partition-rotation	N	Directs DSNADMSB not to check partition rotation.
output-method	D	These two parameters direct DSNADMSB to write data to output data sets that DSNADMSB allocates on volume EDSDMP, with the specified data set names and space allocations.
output-info	DDL;SYSADM.DDL.P12345;EDSDMP;TRK;200;200- +SQL;SYSADM.SQL.P12345;EDSDMP;TRK;200;200- +STATS;SYSADM.STATS.P12345;EDSDMP;TRK;200;200- +COLST;DEFAULT;EDSDMP;TRK;50;50- +EXPL;SYSADM.EXPL.P12345;EDSDMP;TRK;200;200- +PARM;SYSADM.PARM.P12345;EDSDMP;TRK;200;200	
pmr-info	12345.000.000	This is the PMR number for the problem that requires data collection.

The JCL for the step that executes DSNADMSB looks like this:

```
//DSNADMSB EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*,DCB=(RECFM=VB,LRECL=4096)
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
  DSN SYSTEM(DSN)
  RUN PROGRAM(DSNADMSB)  PLAN(DSNADMSB)
//INPUTP  DD *
SYSADM
PLAN_TABLE
DEFAULT
APROGRAM-1-12345
Y
Y
N
Y
NONE
N
D
```

```
DDL;SYSADM.DDL.P12345;EDSDMP;TRK;200;200-
+SQL;SYSADM.SQL.P12345;EDSDMP;TRK;200;200-
+STATS;SYSADM.STATS.P12345;EDSDMP;TRK;200;200-
+COLST;DEFAULT;EDSDMP;TRK;50;50-
+EXPL;SYSADM.EXPL.P12345;EDSDMP;TRK;200;200-
+PARM;SYSADM.PARM.P12345;EDSDMP;TRK;200;200
12345.000.000
```

Example: Collecting data for all rows in a PLAN_TABLE

Suppose that you want DSNADMSB to retrieve data about all rows in a PLAN_TABLE. You want DSNADMSB to generate the names for the output data sets. The generated names are:

- PM11111.D*yymmdd*.D*hhmmss*.COLST
- PM11111.D*yymmdd*.D*hhmmss*.DDL
- PM11111.D*yymmdd*.D*hhmmss*.EXPL
- PM11111.D*yymmdd*.D*hhmmss*.PARM
- PM11111.D*yymmdd*.D*hhmmss*.SQL
- PM11111.D*yymmdd*.D*hhmmss*.STATS

11111 is the PMR number. *yymmdd* and *hhmmss* are the date and time when DSNADMSB ran.

The parameter values that you specify are:

Parameter	Value	Explanation
table-creator	SYSADM	These two parameters direct DSNADMSB to collect data about SYSADM.PLAN_TABLE.
table-name	PLAN_TABLE	
catalog-creator	DEFAULT	For catalog queries, directs DSNADMSB to use the default catalog table qualifier of SYSIBM.
plan-info	%-0-999999	This parameter tells DSNADMSB to collect data for all rows in SYSADM.PLAN_TABLE by requesting all rows for which PROGNAME='%' and 0<=QUERYNO<=999999.
collect-ddl	Y	Directs DSNADMSB to collect the data definition statements that created SYSADM.PLAN_TABLE and associated objects.
collect-stats	Y	Directs DSNADBMSB to collect statistics about tables from the DB2 catalog.
collect-colstats	N	Directs DSNADBMSB not to collect statistics about table columns from the DB2 catalog.
edit-ddl	Y	Directs DSNADMSB to modify the data definition language statements that it generates so that the data definition language statements can be more easily executed by IBM Software Support.

Parameter	Value	Explanation
edit-version-mode	NONE	Directs DSNADMSB not to modify its output to run on a different DB2 version from the version for which the data was collected.
partition-rotation	N	Directs DSNADMSB not to check partition rotation.
output-method	Q	Q directs DSNADMSB to write output data to data sets that DSNADMSB creates. All output data sets have a data set qualifier of SYSADM, a primary allocation quantity of 200, and a secondary allocation quantity of 200.
output-info	DEFAULT-200-200	
pmr-info	11111.000.000	This is the PMR number for the problem that requires data collection.

The JCL for the step that executes DSNADMSB looks like this:

```
//DSNADMSB EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*,DCB=(RECFM=VB,LRECL=4096)
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
  DSN SYSTEM(DSN)
  RUN PROGRAM(DSNADMSB)  PLAN(DSNADMSB)
//INPUTP  DD *
SYSADM
PLAN_TABLE
DEFAULT
%-0-999999
Y
Y
N
Y
NONE
N
Q
DEFAULT-200-200
11111.000.000
```

Example: Collecting data using a table list as input

Suppose that you want DSNADMSB to retrieve data about the DSN8B10.EMP table and the DSN8B10.VDEPT view. You want DSNADMSB to send the output to the job stream.

Before you run DSNADMSB, you need to create a DB2 table with a CREATOR and a TABLE column, and insert rows that contain the qualifiers and names of the tables or views for which you want DSNADMSB to collect data. Use SQL statements like these:

```
CREATE TABLE TL1 (CREATOR VARCHAR(128),
                  TABLE VARCHAR(128));
INSERT INTO TL1 VALUES ('DSN8B10','EMP');
INSERT INTO TL1 VALUES ('DSN8B10','VDEPT');
```

The parameter values that you specify are:

Parameter	Value	Explanation
table-creator	SYSADM	These two parameters direct DSNADMSB to collect data about the tables whose names are in table SYSADM.LIST_TABLE-TL1.
table-name	LIST_TABLE-TL1	
catalog-creator	DEFAULT	For catalog queries, directs DSNADMSB to use the default catalog table qualifier of SYSIBM.
plan-info	NONE	This value must be NONE, because PLAN_TABLE data is not being collected.
collect-ddl	Y	Directs DSNADMSB to collect the data definition statements that created SYSADM.PLAN_TABLE and associated objects.
collect-stats	Y	Directs DSNADBMSB to collect statistics about tables from the DB2 catalog.
collect-colstats	N	Directs DSNADBMSB not to collect statistics about table columns from the DB2 catalog.
edit-ddl	Y	Directs DSNADMSB to modify the data definition language statements that it generates so that the data definition language statements can be more easily executed by IBM Software Support.
edit-version-mode	NONE	Directs DSNADMSB not to modify its output to run on a different DB2 version from the version for which the data was collected.
partition-rotation	N	Directs DSNADMSB not to check partition rotation.
output-method	R	R directs DSNADMSB to write output data to the job stream. When *output-method* is R, *output-info* must be NONE.
output-info	NONE	
pmr-info	12345.000.000	This is the PMR number for the problem that requires data collection.

The JCL for the step that executes DSNADMSB looks like this:

```
//DSNADMSB EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*,DCB=(RECFM=VB,LRECL=4096)
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
  DSN SYSTEM(DSN)
  RUN PROGRAM(DSNADMSB)  PLAN(DSNADMSB)
//INPUTP  DD *
SYSADM
LIST_TABLE-TL1
```

```
DEFAULT
NONE
Y
Y
N
Y
NONE
N
R
NONE
12345.000.000
```

Example: Collecting environment data

Suppose that you want DSNADMSB to retrieve environment data about the ASCHEMA.ATABLE user table. You want DSNADMSB to send the output to the job stream.

The parameter values that you specify are:

Parameter	Value	Explanation
table-creator	ASCHEMA	These two parameters direct DSNADMSB to collect data about table ASCHEMA.ANAME.
table-name	ATABLE	
catalog-creator	DEFAULT	For catalog queries, directs DSNADMSB to use the default catalog table qualifier of SYSIBM.
plan-info	NONE	This value must be NONE, because PLAN_TABLE data is not being collected.
collect-ddl	Y	Directs DSNADMSB to collect the data definition statements that created ASCHEMA.ANAME and associated objects.
collect-stats	Y	Directs DSNADBMSB to collect statistics about tables from the DB2 catalog.
collect-colstats	N	Directs DSNADBMSB to collect statistics about table columns from the DB2 catalog.
edit-ddl	Y	Directs DSNADMSB to modify the data definition language statements that it generates so that the data definition language statements can be more easily executed by IBM Software Support.
edit-version-mode	NONE	Directs DSNADMSB not to modify its output to run on a different DB2 version from the version for which the data was collected.
partition-rotation	N	Directs DSNADMSB not to check partition rotation.

Parameter	Value	Explanation
output-method	R	R directs DSNADMSB to write output data to the job stream. When *output-method* is R, *output-info* must be NONE.
output-info	NONE	
pmr-info	12345.000.000	This is the PMR number for the problem that requires data collection.

The JCL for the step that executes DSNADMSB looks like this:

```
//DSNADMSB EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*,DCB=(RECFM=VB,LRECL=4096)
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
  DSN SYSTEM(DSN)
  RUN PROGRAM(DSNADMSB)  PLAN(DSNADMSB)
//INPUTP  DD *
ASCHEMA
ATABLE
DEFAULT
NONE
Y
Y
N
Y
NONE
N
R
NONE
12345.000.000
```

Collecting data for a table with a long table name with embedded blanks

Suppose that you want to collect the same data as in the previous example for a table with the schema name SYSADM, and the following name, which is 85 bytes long:

```
A234567891 234567892 234567893 234567894 234567895 234567896 234567897-
 234567898 2345
```

The record length of the INPUTP data set is 80 bytes, but only the first 71 bytes can contain input data, so you need to split the schema name and table name across input records. You can split the table name after any non-blank character in the record. DSNADMSB trims blanks at the end of each record.

The INPUTP data set might look like this. The table name is split across three records, after positions 50 and 65.

```
SYSADM
A234567891 234567892 234567893 234567894 234567895
+ 234567896 2345
+67897 234567898 2345
DEFAULT
NONE
Y
Y
N
Y
NONE
```

```
N
R
NONE
12345.000.000
```

The first continued line must contain a blank after the plus sign, because the character at position 51 of the table name is a blank. The second continued line must not contain a blank after the plus sign, because the character at position 66 of the table name is not a blank.

Appendix G. DSNTSMFD

The DSNTSMFD program decompresses DB2 trace records that were compressed when they were written to SMF.

Trace records are compressed when subsystem parameter SMFCOMP is set to ON.

Authorization required

You need no special authorization is needed to run DSNTSMFD.

Input

Input to the DSNTSMFD program is one or more data sets that contain DB2 trace records in standard SMF format. The data sets can contain SMF records of all types, but DSNTSMFD decompresses only SMF type 100, 101, or 102 records.

The input data sets are allocated to DD name SMFINDD.

Output

The DSNTSMFD program produces the following output:

- A data set that contains all of the DB2 trace records that are in the input data set. SMF type 100, 101, or 102 records are decompressed in the output data set.

  If DSNTSMFD cannot decompress the SMF type 100, 101, or 102 records, DSNTSMFD writes the compressed records to the output data set and issues a warning.

  This output data set is allocated to DD name SMFOUTDD.
- A data set that contains details about decompression, such as the number of records that were decompressed, and the amount of space that was saved through compression.

  This output data set is allocated to DD name SYSPRINT.

Before running DSNTSMFD

Certain activities might be required before you run the DSNTSMFD program.

Before running DSNTSMFD:

- Prepare DSNTSMFD for execution.

  Customize and run job DSNTEJDS to do that. The job prolog contains instructions for customization.
- Dump SMF data to sequential data sets.

  Use a utility such as IFASMFDP to do that.

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Data sets that DSNTSMFD uses

The DSNTSMFD utility uses a number of data sets during its operation.

The following table lists the data sets that DSNTSMFD uses.

Table 172. Data sets that DSNTSMFD uses

Data set type	DD name	Description	Required?
Input	SMFINDD	One or more data sets that contain DB2 trace records in standard SMF format. The data sets are sequential data sets that contain the output of an SMF dump utility, such as IFASMFDP.	Yes
Output	SMFOUTDD	A data set into which DSNTSMFD writes the trace records that are in the input data sets, with SMF type 100, 101, and 102 records decompressed. This data set must have the same data set characteristics as the input data set, but must be larger than the total size of all input data sets, to accommodate the decompressed records.	Yes
Output	SYSPRINT	A data set into which DSNTSMFD writes a report about SMF record decompression, such as the number of records that were decompressed, and the amount of space that was saved through compression.	Yes

Examples of DSNTSMFD invocation

Use the DSNTSMFD invocation examples as models for generating your own DSNTSMFD output.

Example: Decompression of DB2 trace records

Suppose that an SMF data set contains compressed DB2 trace records of SMF type 100, 101, or 102. You have dumped the data into sequential data set DSNB10.SMFDATA. You want to write all of the SMF data to data set DSNB10.SMFOUT, and you want any compressed SMF type 100, 101, or 102 records to be decompressed in DSNB10.SMFOUT.

The JCL for the step that executes DSNTSMFD looks like this:

```
//RUNSMFD  EXEC PGM=DSNTSMFD
//SYSPRINT  DD SYSOUT=*
//SYSUDUMP  DD SYSOUT=*
//SMFINDD   DD DSN=DSNB10.SMFDATA,
//             DISP=SHR
//SMFOUTDD  DD DSN=DSNB10.SMFOUT,
```

```
//             LIKE=DSNB10.SMFDATA,
//             DISP=(,CATLG),
//             UNIT=SYSDA,
//             SPACE=(TRK,(1200,200))
```

The output looks like this:

```
*** DSNTSMFD *** STARTING     2011/06/27          15:55:39
-------------------------------------------------------------------------------
Total records read:.............................      146232
  Total DB2 records read:.......................      146183
    Total DB2 compressed records read:..........      146183
    Total DB2 compressed records decompressed:..      146183
  Total non-DB2 records read:...................          49

Aggregate size of all input records:............    60334251           57M
  Aggregate size of all input DB2 records:......    60323008           57M
    Aggregate size of all DB2 compressed records:...60323008           57M
  Aggregate size of all output DB2 records:.....   102449084           97M
    Aggregate size of all DB2 expanded records:...102449084           97M
  Aggregate size of all non-DB2 input records:...       11243           10K

    Percentage saved using compression..........          41%

Details by DB2 subsystem
    Subsystem ID:  DB2A
        Number of records:......................      146183
        Number of compressed records:...........      146183
        Aggregate size of DB2 records:..........    60323008           57M
        Aggregate size of DB2 compressed records:...60323008           57M
        Aggregate size of DB2 expanded records:...102449084           97M
        Percentage saved using compression......          41%
-------------------------------------------------------------------------------
```

Appendix H. How real-time statistics are used by DB2 utilities

DB2 utilities use real-time statistics to optimize data processing and operations.

Utilities can use real-time statistics to calculate how data processing is done. This is more efficient than using statistics typically gathered by the RUNSTATS utility or stored in catalogs.

The use of real-time statistics eliminates some of the dependency on regularly running the RUNSTATS utility, which is processing intensive and time consuming.

Restriction: Real-time statistics does not generate statistics for certain items in the directory, such as the SYSLGRNX table space and its corresponding indexes DSNLLX01 and DSNLLX02, for example.

Using third-party vendor solutions that do not correctly manage real-time statistics can cause unexpected errors.

If real-time statistics are available and the system parameter UTSORTAL is set to YES, the following utilities use real-time statistics to help determine how data is processed:

- CHECK DATA
- CHECK INDEX
- REBUILD INDEX
- REORG TABLESPACE
- RUNSTATS

The REORG TABLESPACE utility also uses real-time statistics to determine the size of a hash space when reorganizing a hash table space and AUTOESTSPACE YES is specified.

Additionally, the RUNSTATS utility uses real-time statistics when determining the number of records to include when collecting a sampling of statistics.

DB2 issues message DSNU3343I if there are no real-time statistics available. This message can be issued for either table spaces or indexes. When message DSNU3343I is returned, DB2 tries to gather real-time statistics either from associated indexes or table spaces, depending on what kind of real-time statistics were not available. If no real-time statistics are available, DB2 uses RUNSTATS based estimations.

When real-time statistics are not available, and a RUNSTATS control statement with TABLESAMPLE SYSTEM *n* is run, RUNSTATS issues a message, and continues with TABLESAMPLE SYSTEM AUTO behavior. If real-time statistics are not available when RUNSTATS is run with TABLESAMPLE SYSTEM AUTO, RUNSTATS sets the sampling rate to 100 and continues to run.

Table space and index characteristics

Utilities regularly gather information about table space or index characteristics. The information is used to calculate statistics that help determine how a utility processes data.

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Utilities read the totals number of rows from the column TOTALROWS in the table SYSIBM.SYSTABLESPACESTATS and the number of associated index keys from column TOTALENTRIES in the table SYSIBM.SYSINDEXSPACESTATS. The statistics that are calculated from this information are used to estimate the number of records that need to be sorted and the size of the required sort work data sets.

Recommendation: To prevent utilities from using incorrect values when table spaces are replaced by utilities such as DSN1COPY or other utilities that are not controlled by DB2, column information can be set to NULL. When information for the columns is set to NULL, the number of records is estimated based on statistics that are gathered by RUNSTATS. The columns are then re-initialized the next time REORG TABLESPACE, LOAD REPLACE, or REBUILD INDEX runs. Alternatively, running RUNSTATS with SHRLEVEL REFERENCE re-initializes the real-time statistics column values.

Related tasks:

Setting up your system for real-time statistics (DB2 Performance)

Appendix I. Delimited file format

A delimited file is a sequential file with column delimiters. Each delimited file is a stream of records, which consists of fields that are ordered by column.

Each record contains fields for one row. Within each row, individual fields are separated by column delimiters. All fields must be delimited character strings, non-delimited character strings, or external numeric values. Delimited character strings can contain column delimiters and can also contain character string delimiters when two successive character string delimiters are used to represent one character.

All characters in all records are in the same CCSID. If EBCDIC or ASCII data contains DBCS characters, the data must be in an appropriate mixed CCSID. If the data is Unicode it must be in CCSID 1208.

The following figure describes the format of delimited files that can be loaded into or unloaded from tables by using the LOAD and UNLOAD utilities.

```
Delimited file ::= Row 1 data ||
                   Row 2 data ||
                   .
                   .
                   .
                   Row n data

Row i data ::= Cell value(i,1) || Column delimiter ||
               Cell value(i,2) || Column delimiter ||
               .
               .
               .
               Cell value(i,m)

Column delimiter ::= Character specified by COLDEL option;
                       the default value is a comma (,)

Cell value(i,j) ::= Leading spaces ||
                    External numeric values ||
                    Delimited character string ||
                    Non-delimited character string ||
                    Trailing spaces

Non-delimited character string ::= A set of any characters except
                                     a column delimiter

Delimited character string ::= A character string delimiter ||
                               A set of any characters except a
                                 character string delimiter unless
                                 the character string delimiter is
                                 part of two successive character
                                 string delimiters ||
                               A character string delimiter ||
                               Trailing garbage

Character string delimiter ::= Character specified by CHARDEL option; the default
                                 value is a double quotation mark (")

Trailing garbage ::= A set of any characters except a column delimiter
```

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Figure 157. Format of delimited files

Related concepts:

"Loading delimited files" on page 323

"Unloading delimited files" on page 873

Data types in delimited files

The LOAD and UNLOAD utilities can process delimited files. When you load a delimited file, LOAD requires that the data in the file be in a certain form depending on the data type. Similarly, when you unload data to a delimited file, UNLOAD writes the data in a certain form depending on the data type.

The following table identifies the acceptable data type forms for the delimited file format that the LOAD and UNLOAD utilities use.

Table 173. Acceptable data type forms for delimited files

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file
CHAR, VARCHAR	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. For VARCHAR, length bytes do not precede the data in the string.
GRAPHIC (any type)[4]	A delimited or non-delimited character stream	Data that is unloaded as a delimited character string. For VARGRAPHIC, length bytes do not precede the data in the string.
INTEGER (any type)[1]	A stream of characters that represents a number in EXTERNAL format	Numeric data in external format.
DECIMAL (any type) [2]	A character string that represents a number in EXTERNAL format	A string of characters that represents a number.
DECFLOAT EXTERNAL	A character string that represents	A SQL numeric constant.
FLOAT [3]	A representation of a number in the range `-7.2E+75` to `7.2E+75` in EXTERNAL format	A string of characters that represents a number in floating-point notation.
BLOB, CLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.
DBCLOB	A delimited or non-delimited character string	Character data that is enclosed by character delimiters. Length bytes do not precede the data in the string.

Table 173. Acceptable data type forms for delimited files (continued)

Data type	Acceptable form for loading a delimited file	Form that is created by unloading a delimited file
DATE	A delimited or non-delimited character string that contains a date value in EXTERNAL format	Character string representation of a date.
TIME	A delimited or non-delimited character string that contains a time value in EXTERNAL format	Character string representation of a time.
TIMESTAMP	A delimited or non-delimited character string that contains a timestamp value in EXTERNAL format	Character string representation of a timestamp.
TIMESTAMP WITH TIME ZONE	A delimited or non-delimited character string that contains a timestamp with time zone value in EXTERNAL format	Character string representation of a timestamp with time zone.

Note:

1. Field specifications of INTEGER or SMALLINT are treated as INTEGER EXTERNAL.
2. Field specifications of DECIMAL, DECIMAL PACKED, or DECIMAL ZONED are treated as DECIMAL EXTERNAL.
3. Field specifications of FLOAT, REAL, or DOUBLE are treated as FLOAT EXTERNAL.
4. EBCID graphic data must be enclosed in shift-out and shift-in characters.

Examples of delimited files

Use the examples as models to specify your own delimited files.

Example 1: Delimited file with delimited character strings

The following figure shows an example of a delimited file with delimited character strings. In this example, the column delimiter is a comma (,). Because the character strings contain the column delimiter character, they must be delimited with character string delimiters. In this example, the character string delimiter is a double quotation mark (").

```
"Smith, Bob",4973,15.46
"Jones, Bill",12345,16.34
"Williams, Sam",452,193.78
```

Figure 158. Example of a delimited file with delimited character strings

Example 2: Delimited file with non-delimited character strings

The following figure shows an example of a delimited file with non-delimited character strings. In this example, the column delimiter is a semicolon (;). Because the character strings do not contain the column delimiter character, they do not need to be delimited with character string delimiters.

```
Smith, Bob;4973;15.46
Jones, Bill;12345;16.34
Williams, Sam;452;193.78
```

Figure 159. Example of a delimited file with non-delimited character strings

Information resources for DB2 for z/OS and related products

Information about DB2 for z/OS and products that you might use in conjunction with DB2 for z/OS is available online in IBM Knowledge Center or on library websites.

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The current DB2 for z/OS publications are available from the following website:

http://www-01.ibm.com/support/docview.wss?uid=swg27039165

Links to IBM Knowledge Center and the PDF version of each publication are provided.

DB2 for z/OS publications are also available for download from the IBM Publications Center (http://www.ibm.com/shop/publications/order).

In addition, books for DB2 for z/OS are available on a CD-ROM that is included with your product shipment:

- DB2 11 for z/OS Licensed Library Collection, LK5T-8882, in English. The CD-ROM contains the collection of books for DB2 11 for z/OS in PDF format. Periodically, IBM refreshes the books on subsequent editions of this CD-ROM.

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Glossary

The glossary is available in IBM Knowledge Center.

See the Glossary topic for definitions of DB2 for z/OS terms.

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Index

Numerics

32K
  option of DSN1COMP utility 943
  option of DSN1COPY utility 956
  option of DSN1PRNT utility 1001

A

abend, forcing 214
ABEND, option of DIAGNOSE utility 211
abnormal-termination, option of TEMPLATE statement 793
Access Method Services, new active log definition 913
access paths
  resetting 774
accessibility
  keyboard xvi
  shortcut keys xvi
ACCESSPATH
  option of MODIFY STATISTICS utility 400
  option of REORG TABLESPACE utility 563
ACHKP 82
ACTION, option of DSN1SDMP utility 1013
ACTION2
  option of DSN1SDMP utility 1013
active log
  adding 913
  data set with I/O error, deleting 915
  defining in BSDS 913
  deleting from BSDS 913
  enlarging 913
  recording from BSDS 913
active status, of a utility 47
AFTER, option of DSN1SDMP utility 1013
AFTER2, option of DSN1SDMP utility 1013
ALIAS, option of DSNJU003 utility 902
ALL
  option of LISTDEF utility 223
  option of REBUILD INDEX utility 431
  option of RUNSTATS utility 754
ALLDUMPS, option of DIAGNOSE utility 211
ARCHIVE
  option of LISTDEF utility 223
archive log
  adding to BSDS 915
  deleting from BSDS 915
ARCHLOG, option of REPORT utility 696
ASCII
  option of LOAD utility 253
  option of UNLOAD utility 820
authorization ID
  naming convention xvii
authorization IDs
  utilities 7
AUXERROR INVALIDATE, option of CHECK DATA utility 102
AUXERROR REPORT, option of CHECK DATA utility 102
AUXERROR, option of CHECK DATA utility 82
auxiliary CHECK-pending (ACHKP) status
  description 1103
auxiliary CHECK-pending (ACHKP) status *(continued)*
  resetting
    for a LOB table space 1103
    for a table space 1103
  set by CHECK DATA utility 82
auxiliary CHECK-pending (ACHKP) status, CHECK DATA utility 82, 104
auxiliary index, reorganizing after loading data 358
auxiliary warning (AUXW) status
  description 1104
  resetting 1104
  set by CHECK DATA utility 82, 102
AUXW 82

B

backout
  point-in-time 494
  RECOVERY utility 494
BACKOUT, option of DSNJU003 utility 902
BACKUP SYSTEM utility
  authorization 59
  before running 63
  compatibility 64
  data sets needed 64
  description 59
  dumping 65
  examples 66
    data-only backup 66
    dump to tape 67
    force 67
    full backup 66
  execution phases 59
  history, printing 923
  log copy pools, 65
  option descriptions 61
  output 59
  restarting 66
  syntax diagram 60
  terminating 66
BASE, option of LISTDEF utility 223
basic predicate 563, 836
before running
  COPY 153
  DSNADMSB 1187
  DSNTSMFD 1197
BETWEEN predicate 563, 836
BIGINT
  option of LOAD utility 282
  option of UNLOAD utility 836
BINARY
  option of LOAD utility 282
  option of UNLOAD utility 836
BIT
  option of LOAD utility for CHAR 282
BLOB
  option of LOAD utility 282
  option of UNLOAD utility 836
BLOBF
  option of LOAD utility for CHAR 282
BOTH, option of RUNSTATS utility 744, 754

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BSDS
active log data set status 935
communication records, printing 923
converting 891
data set references, adding and deleting 917
GENERIC LUNAME parameter, updating 902
LOCATION value, updating 902
LUNAME value, updating 902
PASSWORD value, updating 902
updating 897
VSAM catalog name, changing 902
BUFNO, option of TEMPLATE statement 793

C

CANCEL, option of DSNJU003 utility 902
catalog
updating 73
catalog and directory
creating recovery point of consistency 492
reorganizing 623
REPORT utility 700
catalog indexes, rebuilding 452
catalog name
changing 77
catalog table spaces, corresponding directory table spaces 623
catalog tables
loading data into 303
order of recovering objects 484
outdated information, removing 385
RUNSTATS utility 767
statistics history, clearing outdated information 399
statistics, deleting 403
SYSCOPY
deleting rows 391
SYSCOPY, removing outdated information 385
SYSINDEXES
data collected by STOSPACE utility 785
updating space information 785
SYSINDEXPART
data collected by STOSPACE utility 785
example of query 539
SYSLGRNX
deleting rows 391
outdated information, removing 385
SYSSTOGROUP, data collected by STOSPACE utility 785
SYSTABLEPART
data collected by STOSPACE utility 785
example of query 617
SYSTABLESPACE
data collected by STOSPACE utility 785
updating space information 785
updating 76
CATALOG, option of DSNJU003 utility 902
CATALOG, option of UNLOAD utility 820
catalog, repairing 688
CATENFM utility
authorization 69
compatibility 71
data sets needed 70
description 69
execution phases 69
instructions 70
option descriptions 70
syntax diagram 69
terminating 72
CATMAINT utility
authorization 73
compatibility 76
data sets needed 76
description 73
option descriptions 74
restarting 78
running 70, 76
syntax diagram 73
terminating 78
CCSID
option of LOAD utility 253
option of UNLOAD utility 820
CCSID information, deleting from BSDS 902
CCSIDS, option of DSNJU003 utility 902
change log inventory utility 897
CHANGELIMIT, option of COPY utility 144, 174
CHAR
option of LOAD utility 282
option of UNLOAD utility 836
CHARDEL
option of LOAD utility 253
option of UNLOAD utility 820
CHECK DATA utility
after checking 101
authorization 79
claims and drains 96
compatibility 96
correct constraint violations 100
data sets
shadow 94
data sets needed 92
description 79
examples 105
AUXERROR 106
checking multiple table spaces 107
CLONE 107
creating exception tables 105
deleting invalid data 105
exception tables 105
EXCEPTIONS 106
LOBs 106
maximum number of exceptions 106
PART 106
SCOPE ALL 106
SHRLEVEL CHANGE 107
use after LOAD RESUME 354
using exception tables 354
violation messages 100
exception table, creating 98
execution phases 79
finding violations 100
LOB column errors 102
LOB columns 91
option descriptions 82
output 79
restarting 104
specifying scope 99
syntax diagram 80
table spaces, multiple 107
terminating 104
use after LOAD REPLACE 354
CHECK DATAXML errors 101
CHECK INDEX utility
after checking 124
authorization 109
claims and drains 117

CHECK INDEX utility *(continued)*
compatibility 117
data sets
shadow 115
data sets needed 114
description 109
examples 125
ALL 125
checking all indexes 125
checking clone tables 126
checking more than one index 125
checking one index 125
checking partitions 125
LIST 125
LISTDEF 125
PART 125
SORTDEVT 125
execution phases 109
option descriptions 111
output 109, 123
parallel checking 120
physical or logical partitions 111
restarting 124
single logical partition 119
syntax diagram 110
terminating 124
use after loading table with indexes 357
CHECK LOB
before running 131
CHECK LOB utility
authorization 127
claims and drains 134
compatibility 134
data sets
shadow 132
data sets needed 131
description 127
example 136
execution phases 127
LOB violations, resolving 135
option descriptions 129
output 127
restarting 136
syntax diagram 128
terminating 136
CHECK-pending (CHECKP) status
resetting
for a LOB table space 135
CHECK-pending (CHKP) status
CHECK DATA utility 79, 102
description 1105
indoubt referential integrity 354
resetting 1105
for a table space 354
CHECK, option of DSN1COPY utility 956
CHECKPAGE, option of COPY utility 144
checkpoint queue
printing contents 923
updating 902
CHECKPT, option of DSNJU003 utility 902
CHKP 79
CHKPTRBA, option of DSNJU003 utility 902
CLOB
option of LOAD utility 282
option of UNLOAD utility 836
CLOBF
option of LOAD utility for CHAR 282
CLONE
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of COPY utility 144
option of DIAGNOSE utility 211
option of MERGECOPY utility 375
option of MODIFY RECOVERY utility 387
option of QUIESCE utility 417
option of REBUILD INDEX 431
option of RECOVER utility 463
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
clone objects
recovering a table space 494
CLONED, option of LISTDEF utility 223
CMON, option of CATENFM utility 70
cold start
example, creating a conditional restart control record 915
specifying for conditional restart 902
COLDEL
option of LOAD utility 253
option of UNLOAD utility 820
COLGROUP, option of RUNSTATS utility 744
collecting DB2 subsystem information
DSNADMSB 1179
COLUMN
option of LOAD STATISTICS 253
option of RUNSTATS utility 744
COMMAND, option of DSN1SDMP utility 1013
commit point
DSNU command 36
REPAIR utility LOCATE statement 671
restarting after out-of-space condition 57
comparison operators 563
compatibility
CATENFM utility 71
CATMAINT utility 76
CHECK DATA utility 96
CHECK INDEX utility 117
CHECK LOB utility 134
COPY utility 156
COPYTOCOPY utility 199
declared temporary table 9
DEFINE NO objects 11
DIAGNOSE utility 213
EXEC SQL utility 219
LISTDEF utility 231
LOAD utility 310
MERGECOPY utility 378
MODIFY RECOVERY utility 391
MODIFY STATISTICS utility 402
OPTIONS utility 411
QUIESCE utility 419
REBUILD INDEX utility 442
RECOVER utility 472
REORG INDEX utility 537
REORG TABLESPACE utility 612
REPAIR utility 682
REPORT utility 699
RESTORE SYSTEM utility 733
RUNSTATS utility 764
STOSPACE utility 785
TEMPLATE utility 806
UNLOAD utility 858
utilities access description 47
COMPLETE, option of CATENFM utility 70

compression
data, UNLOAD utility description 877
estimating disk savings 941
concurrency
BACKUP SYSTEM utility 64
utilities access description 47
utility jobs 28
concurrent copies
COPYTOCOPY utility restriction 191
invoking 144
making 172
CONCURRENT, option of COPY utility 144, 172
conditional restart control record
creating 902, 915
reading 937
sample 937
status printed by print log map utility 923
connection-name, naming convention xvii
CONSTANT, option of UNLOAD utility 836
constraint violations, checking 79
CONTINUE, option of RECOVER utility 481
CONTINUEIF, option of LOAD utility 253
continuous operation, recovering an error range 482
control interval
LOAD REPLACE, effect of 313, 358
RECOVER utility
effects 508
REORG TABLESPACE, effect of 647
control statement 22
CONTROL, option of DSNU CLIST command 36
conversion of data, LOAD utility 338
CONVERT, option of CATENFM utility 70
copies
merging 373
online, merging 379
copy
catalog and directory objects 170
XML schema repository objects 171
copy pool 59
COPY SCOPE PENDING
COPY-pending 167
COPY statement, using more than one 169
COPY utility
adding conditional code 174
allowing other programs to access data 144
authorization 139
block size, specifying 153
catalog table, copying 159
checking pages 144
claims and drains 156
compatibility 156
consistency 161
COPY-pending status, resetting 139
copying a list of objects 167
data sets needed 153
description 139
directory, copying 159
examples 179
allowing updates 185
CHANGELIMIT 186
CLONE 189
conditional copies 186
COPYDDN 179
copying LOB table spaces 187
DFSMSdss concurrent copy 186, 187
filter data sets 187
FILTERDDN 187
COPY utility *(continued)*
examples *(continued)*
full image copy 179, 188
incremental image copy 160, 185
JCL-defined and template-defined data sets 184
list of objects, making full image copy of 180
LISTDEF 185
lists 185
local site and recovery site copies 179
multiple image copies 161
PARALLEL 180, 183
parallel processing 183
RECOVERYDDN 179
reporting information 186
REPORTONLY 186
SCOPE PENDING 189
SHRLEVEL 180
TAPEUNITS 183
templates 185
execution phases 139
FlashCopy image copies, overview 163
full image copy, making 159
informational COPY-pending status, resetting 139
JCL parameters 153
MERGECOPY utility, when to use 380
multiple image copies 161
naming data sets 161
option descriptions 144
output 139
partition, copying 160
performance recommendations 176
processing in parallel
description 144, 167
number of threads 139, 167
recovery, preparing for 175
restart current 178
restarting
description 178
new data set 178
out-of-space condition 178
restricted states 156
restrictions 160
separate jobs 169
syntax diagram 141
table spaces 170
TERM UTILITY command 178
terminating
DD statements 178
description 178
using more than one COPY statement 169
COPY-pending status
COPY utility 144
description 1106
LOAD utility 353
resetting
by taking a copy 1106
by using COPY 156
by using LOAD 353
copy, consistency 161
COPY, option of LISTDEF utility 223
COPY1, option of DSNJU003 utility 902
COPY1VOL, option of DSNJU003 utility 902
COPY2, option of DSNJU003 utility 902
COPY2VOL, option of DSNJU003 utility 902
COPYDDN
option of COPY utility 144
option of COPYTOCOPY utility 194

COPYDDN *(continued)*
option of LOAD utility 253, 332
option of MERGECOPY utility 375
option of REORG TABLESPACE utility 563, 629
COPYDSN, option of DSNU CLIST command 36
COPYDSN2, option of DSNU CLIST command 36
copying
FlashCopy image copies, overview 163
COPYTOCOPY statements, using multiple 201
COPYTOCOPY utility
authorization 191
block size, specifying 197
claims 199
compatibility 199
copying from a specific image copy 201
data sets needed 197
description 191
examples
cataloged copy data set, specifying 206
CLONE 208
copying from a specific image copy 201
copying objects from tape 203
FROMCOPY 201, 206
FROMLASTCOPY 205
FROMLASTFULLCOPY 206
FROMVOLUME 206
full image copy 200
incremental image copy 200
input copy data set, specifying 206
list of objects, processing 207
LISTDEF 207, 208
local backup copies, making 205
TEMPLATE 207, 208
uncataloged data set, specifying 206
execution phases 191
FlashCopy 201
generation data groups, defining 203
input copy, determining which to use 202
JCL parameters 197
lists, copying 194
making copies 200
multiple statements, using 201
objects, copying from tape 203
option descriptions 194
output 191
output data sets
size 197
specifying 194
partitions, copying 194
syntax diagram 193
SYSIBM.SYSCOPY records, updating 202
tape mounts, retaining 197
terminating 205
using TEMPLATE 202
correlation ID, naming convention xvii
COUNT
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of RUNSTATS utility 744
COUNT option
option of RUNSTATS utility 744, 754
CREATE option of DSNJU003 utility 902
CRESTART, option of DSNJU003 utility 902
cross loader 331
cross loader function 217
CSRONLY, option of DSNJU003 utility 902
CURRENT DATE, incrementing and decrementing value 836
CURRENT option of REPORT utility 696
current restart, description 52
CURRENTCOPYONLY option of RECOVER utility 463
cursor
naming convention xvii
CYL, option of TEMPLATE statement 793

D

data
adding 318
compressing 328
converting 330
converting with LOAD utility 338
deleting 319
DATA
option of CHECK DATA utility 82
option of LOAD utility 253
option of REPAIR DUMP 678
option of REPAIR REPLACE 675
option of REPAIR VERIFY 674
option of UNLOAD utility 820
data compression
dictionary
building 328
number of records needed 328
using again 328
LOAD utility
description 328
KEEPDICTIONARY option 253, 328
REORG TABLESPACE utility, KEEPDICTIONARY option 563
DATA ONLY, option of BACKUP SYSTEM utility 61
data set
name format in ICF catalog 144
name limitations 807
data set templates
extent allocations 808
space calculations 808
data sets
BACKUP SYSTEM utility 64
CATENFM utility 70
CATMAINT utility 76
change log inventory utility (DSNJU003) 897
CHECK DATA utility 92
CHECK INDEX utility 114
CHECK LOB utility 131
concatenating 18
COPY utility 153
copying partition-by-growth table spaces 170
copying table space in separate jobs 169
COPYTOCOPY utility 197
definitions, changing during REORG 626
DIAGNOSE utility 213
disposition
defaults for dynamically allocated data sets 793
defaults for dynamically allocated data sets on RESTART 793
disposition, controlling 18
DSNADMSB 1188
DSNJCNVB utility 891
DSNJCNVT utility 893
DSNTSMFD 1198
for copies, naming 161
input, using 18
LOAD utility 304

data sets *(continued)*
MERGECOPY utility 377
MODIFY RECOVERY utility 390
MODIFY STATISTICS utility 402
naming convention xvii
output, using 18
QUIESCE utility 419
REBUILD INDEX utility 440
RECOVER utility 472
recovering, partition 479
REORG INDEX utility 533
REORG TABLESPACE utility 604
REPAIR utility 681
REPORT utility 699
RESTORE SYSTEM utility 732
RUNSTATS utility 762
security 18
space parameter, changing 533
space parameter, changing during REORG 626
specifying 18
STOSPACE utility 784
UNLOAD utility 857
data sharing
backing up group 59
restoring data 733
data type, specifying with LOAD utility 282
data-only backup
example 66
explanation 61
database
limits 1025
naming convention xvii
DATABASE
option of LISTDEF utility 223
option of REPAIR utility 679
DATACLAS, option of TEMPLATE statement 793
DATAONLY
option of REPAIR utility 677
DATAONLY, option of DSN1LOGP utility 982
DataRefresher 330
DATE EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
DB2 data compression, estimating disk savings 941
DB2 internal format
LOAD utility 312
DB2 subsystem information, collecting
DSNADMSB 1179
DB2-supplied stored procedures 1033
DB2I
option of DSNU CLIST command 36
using to invoke online utilities 29
DBCLOB
option of LOAD utility 282
option of UNLOAD utility 836
DBCLOBF
option of LOAD utility for CHAR 282
DBD statement of REPAIR utility 144, 679
DBD, reclaiming space in 393
DBD01 directory table space
MERGECOPY restrictions 373, 375
order of recovering 484
DBETE status
description 1107
resetting
by using START DATABASE command 1107
DBID
option of DSN1LOGP utility 982
option of REPAIR utility 679
DBRM (database request module)
member naming convention xvii
partitioned data set naming convention xvii
DD name, naming convention xvii
DDF (distributed data facility), option of DSNJU003 utility 902
DDNAME, option of DSNJU004 utility 925
DEACTIV, option of DSNJU003 utility 902
DEADLINE
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
DECFLOAT
option of LOAD utility 282
option of UNLOAD utility 836
DECFLOAT EXTERNAL
option of UNLOAD utility 836
DECFLOAT_ROUNDMODE
option of LOAD utility 253
option of UNLOAD utility 820
DECIMAL EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
DECIMAL PACKED
option of the LOAD utility 282
option of UNLOAD utility 836
DECIMAL ZONED
option of the LOAD utility 282
option of UNLOAD utility 836
DECIMAL, option of UNLOAD utility 836
declared temporary table
REPAIR utility 679
utility compatibility 9
decompressing DB2 SMF trace records
DSNTSMFD 1197
DECPT
option of LOAD utility 253
option of UNLOAD utility 820
DEFAULTIF, option of LOAD utility 282
defects, calculating, LOAD utility 304
DEFINE NO objects
populating 11
utility compatibility 11
DEFINE NO table space, loading data 319
defining work data sets
CHECK DATA utility 93
DELAY
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
DELETE
option of CHECK DATA utility 82
option of DSNJU003 utility 902
option of MODIFY RECOVERY utility 387
option of MODIFY STATISTICS utility 400
option of the CHECK DATA utility 100
statement of REPAIR utility, used in LOCATE block 670
DELETE statement of REPAIR utility 676
deleting
active log from BSDS 913
log data sets with errors 915
DELIMITED
option of LOAD utility 253
option of UNLOAD utility 820

delimited file format
acceptable data types 323, 1204
default delimiter values 323, 873
description 1203
examples 1205
loading 253, 323
maximum delimiter values 323
restrictions 323
delimited files
acceptable data type forms for LOAD and UNLOAD utilities 873
unloading 873
delimiters
column 1203
default values 323, 873
maximum values 323
restrictions 873
string 1203
using 323
DELMBR, option of DSNJU003 utility 902
DESTROY, option of DSNJU003 utility 902
determining input copies 379
DFSMS (Data Facility Storage Management Subsystem)
concurrent copy
invoking with COPY utility 144, 172
requirements for using 172
restrictions 172
products, using with DB2 177, 203
DFSMSdss COPY operation with utilities
refining with subsystem parameters 48
DIAGNOSE utility
ABEND statement
description 211
syntax diagram 209
authorization 209
compatibility 213
concurrency 213
data sets needed 213
description 209
DISPLAY statement
description 211
syntax diagram 209
examples 214
ABEND 215
ALLDUMPS 214
CLONE 216
diagnosis of a specific type 215
displaying MEPLs 214
forcing a dump 214
forcing an abend 215
service level, finding 214
suspending utility execution 216
TYPE 215
WAIT 216
forcing an abend 214
instructions 214
option descriptions 211
restarting 214
syntax diagram 209
terminating 214
WAIT statement
description 211
syntax diagram 209
DIAGNOSE, option of REPAIR utility 679
DIR, option of TEMPLATE statement 793
directory
MERGECOPY utility, restrictions 373
directory *(continued)*
order of recovering objects 484
disability xvi
discard data set, specifying DD statement for LOAD utility 253
DISCARD, option of REORG TABLESPACE utility 563
DISCARDDN
option of LOAD PART 282
option of LOAD utility 253
option of REORG TABLESPACE utility 563
DISCARDS, option of LOAD utility 253
DISCDSN, option of DSNU CLIST command 36
DISP, option of TEMPLATE statement 793
DISPLAY DATABASE command, displaying range of pages in error 482
DISPLAY UTILITY command
description 47
using with RESTORE SYSTEM utility on a data sharing group 733
DISPLAY, option of DIAGNOSE utility 211
displaying status of DB2 utilities 47
disposition, data sets, controlling 18
DL/I, loading data 330
DOUBLE, option of UNLOAD utility 836
DRAIN
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
DRAIN_WAIT
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
DROP, option of REPAIR utility 679
DSN, option of TEMPLATE statement 793
DSN1COMP utility
authorization required 941
data set size, specifying 943
data sets required 941
DD statements
SYSPRINT 941
SYSUT1 941
description 941
environment 941
examples
EXTNDICT 950
free space 948
FREEPAGE 948
full image copy 948
FULLCOPY 948
LARGE 949
NUMPARTS 949
PCTFREE 948
REORG 949, 950
ROWLIMIT 948
free pages, specifying 943
free space
including in compression calculations 947
specifying 943
FREEPAGE 947
full image copy as input, specifying 943
LARGE data sets, specifying 943
maximum number of rows to evaluate, specifying 943
message DSN1941 950
option descriptions 943

DSN1COMP utility *(continued)*
output
example 950
interpreting 950
sample 947, 950
page size of input data set, specifying 943
partitions, specifying number 943
PCTFREE 947
prerequisite actions 946
recommendations 941
REORG 947
running 941
savings comparable to REORG 943
savings estimate 947
syntax diagram 943
DSN1COPY utility
additional volumes, for SYSUT2 963
altering a table before running 961
authorization required 953
checking validity of input 956
comparing to DSN1PRNT 961
copying a table space 961
copying identity column tables 972
copying tables to other subsystems 972
data set size, determining 961
data set size, specifying 956
data sets
input 963
message 963
OBIDXLAT 963
output 963
required 963
DD statements
SYSPRINT 963
SYSUT1 963
SYSUT2 963
SYSXLAT 963
description 953
environment 953
example 963
examples 974
checking input data 974
copying partitions 975, 976
printing 16 pages 975
printing one page 975
translating internal identifiers 974
full image copy, specifying 956
image copy, using as input 969
inconsistent data, checking for 968
incremental copy, specifying 956
inline copy, specifying 956
internal identifiers, translating 968
LARGE input data set, specifying 956
LOB table space, specifying 956
maximum piece size, specifying 956
multiple data set table spaces 969
OBID translation 956
OBIDXLAT 961
option descriptions 956
page size of input data set, specifying 956
page size, determining 961
partitions, specifying number 956
preventing inconsistent data 968
printing data sets 972
printing in hexadecimal format 956
resetting log RBAs 956
restoring indexes 970
DSN1COPY utility *(continued)*
restoring table spaces 970
restrictions 953
scanning input data set for value 956
segmented table space, specifying 956
subsystem, copying tables from one to another 972
syntax diagram 956
translating internal identifiers 968
DSN1LOGP utility
archive log data sets on tape, reading 989
authorization 979
data changes, limiting report to 982
data sets required 980
data sharing example 990
data sharing requirements 981
database identifier, using to limit report 982
DBID, using to limit report 982
DD statements
ACTIVE 980
ARCHIVE 980
BSDS 980
SYSIN 980
SYSPRINT 980
SYSSUMRY 980
description 979
detail report
description 993
sample 993
environment 979
error codes, interpreting 993
examples
data sharing 990
extracting information from the active log without the BSDS 990
extracting information from the archive log without the BSDS 990
extracting information from the recovery log with the BSDS 990
SUMMARY option 990
JCL, requirements 980
log data sets, identifying 980
log range, specifying 982
LUWIDs, reporting on 982
option descriptions 982
output
description 993
reviewing 993
sample 993
page regression report
description 993
page, limiting report to 982
RID, using to limit report 982
running 979
summary report
description 993
description of data propagation information 993
sample 993
sample of data propagation information 993
summary report, specifying 982
syntax diagram 982
SYSCOPY log records, limiting report to 982
type of log records, limiting report by 982
unit of recovery identifier, using to limit report 982
value in log record, limiting report by 982
DSN1PRNT utility
authorization required 999
comparison with DSN1COPY utility 1006

DSN1PRNT utility *(continued)*
data set size, determining 1006
data set size, specifying 1001
data sets required 999
DD statements
SYSPRINT 999
SYSUT1 999
description 999
environment 999
examples 1007
printing a data set in hexadecimal format 1007
printing a nonpartitioning index 1007
printing a page range of a specific partition 1008
printing a partitioned data set 1008
printing a single page of an image copy 1007
filtering pages by value 1001
formatting output 1001
full image copy, specifying 1001
incremental copy, specifying 1001
inline copy, specifying 1001
LARGE data set, specifying 1001
LOB table space, specifying 1001
number of partitions, specifying 1001
option descriptions 1001
page size, determining 1006
page size, specifying 1001
piece size, specifying 1001
processing encrypted data 999
recommendations 1006
running 999
syntax diagram 1001
SYSUT1 data set, printing on SYSPRINT data set 1001
DSN1SDMP utility
action, specifying 1013
authorization required 1011
buffers, assigning 1017
DD statements
SDMPIN 1011
SDMPPRNT 1011
SDMPTRAC 1011
SYSABEND 1011
SYSTSIN 1011
description 1011
dump, generating 1018
environment 1011
examples
abend 1019, 1020
dump 1021
second trace 1022
skeleton JCL 1019
option descriptions 1013
output 1011
required data sets 1011
running 1011
selection criteria, specifying 1013
syntax diagram 1013
trace destination 1013
traces
modifying 1018
stopping 1018
DSN1SMFP utility 1133
authorization 1135
control statement 1135
environment 1135
examples
extracting, formating, and printing SMF records 1135
JCL, requirements 1135
DSN1SMFP utility *(continued)*
output 1136
dedicated report DD 1136
IFCID003 DD 1139, 1145
IFCID004 DD 1140
IFCID005 DD 1141
IFCID023 DD 1141
IFCID024 DD 1144
IFCID083 DD 1146
IFCID106 DD 1147
IFCID140 DD 1156
IFCID141 DD 1162
IFCID142 DD 1163
IFCID143 DD 1165
IFCID144 DD 1166
IFCID145 DD 1166
IFCID269 DD 1168
IFCID270 DD 1170
IFCID350 DD 1170
IFCID361 DD 1172
IFCID362 DD 1176
standard report header 1137
SYSPRINT DD 1178
output record structure 1137
required input
DSNHDECP 1135
SMFIN DD 1135
running 1135
DSN8G810, updating space information 785
DSN8S81E table space, finding information about space utilization 785
DSNACCOR stored procedure
description 1048
option descriptions 1050
output 1065
syntax diagram 1050
DSNACCOX stored procedure
description 1069
option descriptions 1072
output 1093
syntax diagram 1071
DSNADMSB
data sets needed 1188
description 1179
examples 1189
syntax diagram 1180
using the collected data 1188
DSNADMSB utility
examples
collecting data for all rows in a PLAN_TABLE 1191
collecting environment data 1194
PLAN_TABLE data 1189
table list 1192
DSNAME, option of DSNJU003 utility 902
DSNDB01.DBD01
copying restrictions 160
recovery information 700
DSNDB01.SYSCOPYs
copying restrictions 160
DSNDB01.SYSUTILX 492
copying restrictions 160
recovery information 700
DSNDB06.SYSTSCPY
recovery information 700
DSNJCNVB utility
authorization required 891
control statement 891

DSNJCNVB utility *(continued)*
data sets used 891
description 891
dual BSDSs, converting 891
environment 891
example 891
output 892
prerequisite actions 891
running 891
SYSPRINT DD name 891
SYSUT1 DD name 891
SYSUT2 DD name 891
DSNJCNVT utility
authorization required 893
control statement 893
data sets used 893
description 893
environment 893
example 894
output 894
prerequisite actions 893
running 893
SYSPRINT DD name 893
SYSUT1 DD name 893
SYSUT2 DD name 893
SYSUT3 DD name 893
SYSUT4 DD name 893
DSNJLOGF utility
data sets required 895
description 895
example 896
output 896
SYSPRINT DD name 895
SYSUT1 DD name 895
DSNJU003 utility
active logs
adding 913
changing 913
deleting 913
enlarging 913
recording 913
altering references 917
archive logs
adding 915
changing 915
deleting 915
authorization required 897
BSDS timestamp field, updating 897
data sets
cataloging 902
declaring 902
data sets needed 897
DELETE statement 917
description 897
environment 897
examples 919
adding a communication record to BSDS 919
adding a communication record with an alias to BSDS 920
adding active log 913
adding archive log 915
adding archive log data set 919
alias ports 920
changing high-level qualifier 917
creating conditional restart control record 919
deleting a data set 919
deleting active log 913
DSNJU003 utility *(continued)*
examples *(continued)*
deleting archive log 915
recording active log 913
removing aliases from a communication record 921
specifying a point in time for system recovery 920
SYSPITR 920
Updating a communication record with a secure TCP/IP port number in the BSDS 920
invoking 897
NEWCAT statement
example output 917
using 917
NEWLOG statement 917
option descriptions 902
renaming log data sets 918
renaming system data sets 918
syntax diagram 898
SYSIN DD name 897
SYSPRINT DD name 897
SYSUT1 DD name 897
SYSUT2 DD name 897
updating dual copy BSDSs 897
DSNJU004 utility
authorization required 923
BSDS timestamps 934
checkpoints, sample output description of 937
data sets needed 923
description 923
environment 923
example 925
GROUP DD name 923
MnnBSDS DD name 923
option descriptions 925
output
description 926
sample 936
recommendations 923
running 923
syntax diagram 925
SYSIN DD name 923
SYSPRINT DD name 923
SYSUT1 DD name 923
DSNTEJ1 sample 599
DSNTEP2 and DSNTEP4 sample program
specifying SQL terminator 1118, 1126
DSNTEP2 sample program
how to run 1117
parameters 1117
program preparation 1117
DSNTEP4 sample program
how to run 1117
parameters 1117
program preparation 1117
DSNTIAD sample program
how to run 1117
parameters 1117
program preparation 1117
specifying SQL terminator 1124
DSNTIAUL sample program
how to run 1117
parameters 1117
program preparation 1117
DSNTIJIC utility
copy catalog and directory objects 170
DSNTSMFD
data sets needed 1198

DSNTSMFD *(continued)*
description 1197
examples 1198
DSNTSMFD utility
examples
PLAN_TABLE data 1198
DSNTYPE, option of TEMPLATE statement 793
DSNU CLIST command
examples 34
invoking utilities 34
option descriptions 36
output 40
syntax 36
DSNU473I 423
DSNUM
option of COPY utility 144
option of COPYTOCOPY utility 194
option of MERGECOPY utility 375
option of MODIFY RECOVERY utility 387, 391
option of RECOVER utility 463
option of REPORT utility 696
DSNUPROC JCL procedure
description 41
option descriptions 42
sample 43
DSNUTILS stored procedure
authorization required 1034
data sets 1034, 1035
description 1033
option descriptions 1036
output 1044
restarting a utility 1033
sample JCL 1044
syntax diagram 1036
terminating a utility 1033
DSNUTILU stored procedure
authorization required 1045
data sets 1046
description 1044
option descriptions 1046
output 1048
restarting a utility 1044
sample JCL 1048
syntax diagram 1046
DSSIZE
option of DSN1COMP utility 943
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
dump
example 67
DUMP
statement of REPAIR utility 677
used in LOCATE block 670
DUMP, option of BACKUP SYSTEM utility 61
DUMPCLASS, option of BACKUP SYSTEM utility 61
dumping
utilities
BACKUP SYSTEM 65
DUMPONLY, option of BACKUP SYSTEM utility 61

E

EBCDIC
option of LOAD utility 253
option of UNLOAD utility 820
edit routine
LOAD utility 245
edit routine *(continued)*
REORG TABLESPACE utility 563
EDIT, option of DSNU CLIST command 36
embedded semicolon
embedded 1124
enabling-new-function mode processing, stopping 72
encrypted data
running DSN1PRNT on 999
running REORG TABLESPACE on 599
running REPAIR on 681
running UNLOAD on 857
running utilities on 13
encryption
DSN1PRNT utility effect on 999
REORG TABLESPACE utility effect on 599
REPAIR utility effect on 681
UNLOAD utility effect on 857
utilities effect on 13
END FCINCREMENTAL
explanation 61
END FCINCREMENTAL, option of BACKUP SYSTEM utility 61
END, option of DIAGNOSE utility 211
ENDLRSN, option of DSNJU003 utility 902
ENDRBA, option of DSNJU003 utility 902
ENDTIME, option of DSNJU003 utility 902
ENFMON, option of CATENFM utility 70
ENFORCE, option of LOAD utility 253, 326
ERRDDN
option of CHECK DATA utility 82
option of LOAD utility 253
error data set
CHECK DATA utility 82, 92
error range recovery 482
ERROR RANGE, option of RECOVER utility 463
error, calculating, LOAD utility 304
ESCAPE clause 563, 836
ESTABLISH FCINCREMENTAL
explanation 61
ESTABLISH FCINCREMENTAL, option of BACKUP SYSTEM utility 61
EVENT, option of OPTIONS statement 408
exception table
columns 98
creating 98
definition 92
example 105
with auxiliary columns 99
with LOB columns 91
EXCEPTIONS
option of CHECK DATA utility 82
option of CHECK LOB utility 129
exceptions, specifying the maximum number
CHECK DATA utility 82
CHECK LOB utility 129
EXCLUDE
option of LISTDEF 232
EXCLUDE, option of LISTDEF utility 223
EXEC SQL utility
authorization 217
compatibility 219
cursors 218
declare cursor statement
description 218
syntax diagram 217
description 217
dynamic SQL statements 218

EXEC SQL utility *(continued)*
examples 219
creating a table 219
declaring a cursor 220
inserting rows into a table 220
using a mapping table 659
execution phase 217
output 217
restarting 219
syntax diagram 217
terminating 219
EXEC statement
built by CLIST 40
description 44
executing
utilities, creating JCL 44
utilities, DB2I 29
utilities, JCL procedure (DSNUPROC) 41
exit procedure, LOAD utility 345
EXPDL, option of TEMPLATE statement 793
extracted key, calculating, LOAD utility 304

F

fallback recovery considerations 599
FAROFFPOSF column of SYSINDEXPART catalog table
catalog query to retrieve value for 617
field procedure, LOAD utility 345
filter data set, determining size 153
FILTER, option of DSN1LOGP utility 982
FILTER, option of DSN1SDMP utility 1013
FILTERDDN, option of COPY utility 144
FlashCopy
copying 201
COPYTOCOPY 201
creating with LOAD 333
creating with REBUILD INDEX 452
creating with REORG INDEX 542
creating with REORG TABLESPACE 630
image copies, overview 163
recovering from 480
utilities that support FlashCopy 163
FLASHCOPY
option of COPY utility 144
option of REBUILD INDEX utility 431
FlashCopy image copies
examples
REBUILD TABLESPACE control statement 662
REORG INDEX control statement 549
FLOAT
option of LOAD utility 253
option of UNLOAD utility 820, 836
FLOAT EXTERNAL, option of LOAD utility 282
FLOAT, option of LOAD utility 282
FOR EXCEPTION, option of CHECK DATA utility 82
FOR, option of DSN1SDMP utility 1013
FOR2, option of DSN1SDMP utility 1013
force
example 67
FORCE, option of BACKUP SYSTEM utility 61
FORCEROLLUP
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744, 754
foreign key, calculating, LOAD utility 304
FORMAT
option of DSN1PRNT utility 1001
option of LOAD utility 253
FORMAT INTERNAL
LOAD utility 312
option of UNLOAD utility 820
FORMAT INTERNAL, option of LOAD utility 253
FORMAT SQL/DS, option of LOAD utility 253
FORMAT UNLOAD, option of LOAD utility 253
FORWARD, option of DSNJU003 utility 902
free space
REORG INDEX utility 546
FREEPAGE, option of DSN1COMP utility 943
FREQVAL
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of RUNSTATS utility 744, 754
FROM TABLE
option of UNLOAD utility 831, 878
FROMCOPY
option of COPYTOCOPY utility 194
option of the COPYTOCOPY utility 201
option of UNLOAD utility 820, 864
FROMCOPYDDN, option of UNLOAD utility 820, 864
FROMLASTCOPY, option of COPYTOCOPY utility 194
FROMLASTFULLCOPY, option of COPYTOCOPY utility 194
FROMLASTINCRCOPY, option of COPYTOCOPY utility 194
FROMSEQNO, option of the UNLOAD utility 820
FROMVOLUME
option of COPYTOCOPY utility 194
option of UNLOAD utility 820
FULL
option of BACKUP SYSTEM utility 61
option of COPY utility 144
full backup
description 61
example 66
FULLCOPY
option of DSN1COMP utility 943
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
function
maximum number in select 1025

G

GDGLIMIT
option of MODIFY RECOVERY utility 387
GDGLIMIT, option of TEMPLATE statement 793
GDGs 177
general-use programming information, described 1211
generation data groups
defining 177, 203
using with conditional copy 174
GENERIC, option of DSNJU003 utility 902
GRAPHIC
option of LOAD utility 282
option of UNLOAD utility 836
GRAPHIC EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
GRECP 1108
group buffer pool RECOVER-pending (GRECP) status
description 1108
resetting 1108
GUPI symbols 1211

H

HALT, option of OPTIONS statement 408
HEADER, option of UNLOAD utility 836
hexadecimal-constant, naming convention xvii
hexadecimal-string, naming convention xvii
HIGHRBA, option of DSNJU003 utility 902
HISTOGRAM
  option of RUNSTATS utility 744, 754
HISTORY
  option of LOAD STATISTICS 253
  option of REBUILD INDEX utility 431
  option of REORG INDEX utility 518
  option of REORG TABLESPACE utility 563
  option of RUNSTATS utility 744, 754

I

ICBACKUP column in SYSIBM.SYSCOPY 161
ICOPY status 139
ICUNIT column
  SYSIBM.SYSCOPY 161
identity columns, loading 316
IFCID003 DD 1139
  COMMIT RECEIVED field 1139
  COMMIT SENT field 1139
  REMOTE LOCATION field 1139
  REQ.ELAPSED TIME field 1139
  ROLLBK RECEIVED field 1140
  ROLLBK SENT field 1139
  SER.ELAPSED TIME field 1140
IFCID004 DD 1140
  MESSAGE field 1140
  QW0004CM field 1140
  QW0005CM field 1141
IFCID005 DD 1141
  MESSAGE field 1141
IFCID023 DD 1141
  COPY CHECKPAGE field 1142
  COPY CONCURRENT field 1142
  COPY PARALLEL field 1142
  COPY SHRLEVEL CHANGE field 1142
  DBID field 1141
  LOAD COPYDDN field 1143
  LOAD KEEPDICTIONARY field 1141
  LOAD LOG NO field 1142
  LOAD PART INDDN field 1143
  LOAD REUSE field 1142
  LOAD SHRLEVEL CHANGE field 1143
  LOAD SORTKEYS field 1142
  LOAD STATISTICS field 1143
  OBID field 1141
  REBUILD REUSE field 1142
  REBUILD SORTKEYS field 1142
  REBUILD STATISTICS field 1142
  REBUILD WORKDDN field 1142
  RECOVER PARALLEL field 1143
  RECOVER REUSE field 1143
  REORG COPYDDN field 1143
  REORG FASTSWITCH field 1144
  REORG KEEPDICTIONARY field 1141
  REORG LOG NO field 1142
  REORG NOSYSREC field 1143
  REORG REUSE field 1142
  REORG SHRLEVEL CHANGE field 1143
  REORG SHRLEVEL REFERENCE field 1143
  REORG SORTDATA field 1143
IFCID023 DD *(continued)*
  REORG SORTKEYS field 1142
  REORG STATISTICS field 1144
  RQSTASK field 1141
  RUNSTATS SAMPLE field 1143
  RUNSTATS SHRLEVEL CHANGE field 1143
  UNLOAD SHRLEVEL CHANGE ISOLATION CS field 1144
  UNLOAD SHRLEVEL CHANGE ISOLATION UR field 1144
  UNLOAD SHRLEVEL REFERENCE field 1144
  UTILITY ID field 1141
  UTILITY NAME field 1141
  UTILITY PHASE field 1141
IFCID024 DD 1144
  DBID field 1144
  DBNAME field 1145
  ITEMS field 1145
  OBID field 1144
  OBJECT NAME field 1145
  PART/DATASET# field 1145
  UTILITY ID field 1145
  UTILITY NAME field 1144
  UTILITY PHASE field 1145
IFCID025 DD 1145
  DBID field 1145
  ITEMS field 1146
  OBID field 1145
  UTILITY ID field 1146
  UTILITY NAME field 1145
  UTILITY PHASE field 1145
IFCID083 DD 1146
  ACCESS field 1146
  ACEE UTOKEN field 1146
  CONNECTION TYPE field 1147
  CURR SQLID field 1146
  ORIG AUTHID field 1146
  REASON CODE field 1146
  RECOPT field 1146
  RETURN CODE field 1146
  SECONDARY AUTHORIZATION IDS field 1146
IFCID106 DD 1147
  AUDIT CLASSES field 1147
  AUTH. CACHE SIZE field 1151
  CACHE DYNAMIC SQL field 1151
  COMCRIT field 1148
  DATA SHARING ENABLED field 1155
  DBADM CREATE VIEW field 1151
  DBAT STATUS field 1154
  DDL REGISTRATION FLAG field 1148
  DECIMAL POINT OPTION field 1156
  DEFAULT ENCODING SCHEME field 1156
  DEFAULT SUBSYSTEM field 1156
  DEFAULT USERID field 1150
  EBCDIC SBCS CCSID field 1156
  EDM STATEMNT CACHE field 1152
  ENABLE DB2 AUTHORIZATION field 1151
  EXT. SECURITY field 1148
  FACILITY NAME field 1154
  FACILITY START field 1154
  GROUP NAME field 1155
  INSTALL SYSADM field 1150
  MEMBER NAME field 1155
  MONITOR BUFFER SIZE field 1147
  ONL SYSPARM CORID field 1152
  ONL SYSPARM TIME field 1152
  ONL SYSPARM TYPE field 1152

IFCID106 DD *(continued)*
ONL SYSPARM USER ID field 1152
PACK AUTH CACHE field 1151
PAR.ASSIST field 1155
PAR.COORD field 1155
RESYNCH.INTERVAL field 1154
REVOKE DEP. PRIVILEGES field 1153
SECURITY ADMIN 1 field 1153
SECURITY ADMIN 1 TYPE field 1152
SECURITY ADMIN 2 field 1153
SECURITY ADMIN 2 TYPE field 1152
SECURITY TASKS field 1153
SITE TYPE field 1150
SYSADM ID 2 field 1150
SYSOPER ID 2 field 1151
SYSOPER ID field 1151
TCP/IP KEEPALIVE field 1154
TCP/IP VERIFIED field 1154
UNICODE IFCIDS field 1148
VERSION field 1155
WTO ROUTE CODES field 1147
IFCID140 DD 1156
ACEE UTOKEN field 1161
AUTH CHECKED field 1156
AUTHID TYPE field 1156
OBJECT field 1159
OPTIONS field 1160
PRIV CHECKED field 1157
REASON field 1156
RETCOD field 1157
RID OF ROW field 1162
SECLABEL OF ROW field 1162
SOURCE OBJECT field 1161
SOURCE OWNER field 1161
SQL STMT field 1161
STATMNT LENGTH field 1157
TARGET OBJECT field 1161
TARGET OWNER field 1161
IFCID141 DD 1162
AUTHID TYPE field 1162
GRANTOR/REVOKER field 1162
OBJECT field 1162
OPTIONS field 1163
REASON field 1162
RETURN field 1162
SQL STMT field 1163
IFCID142 DD 1163
AUDIT DDL field 1164
DATABASE field 1164
MULTILEVEL SECURITY field 1164
OPTIONS field 1164
ROW/COLUMN ACCESS CONTROL field 1164
SECLABEL OF MLS TABLE field 1164
SQL STMT field 1165
TABLE CREATOR field 1164
TABLE NAME field 1164
TABLE OBID field 1164
TABLE OWNER field 1164
TABLE OWNER TYPE field 1164
IFCID143 DD 1165
DATABASE field 1165
LOGRBA field 1165
PAGESET field 1165
STATEMENT ID field 1165
TABLE OBID field 1165
IFCID144 DD 1166
DATABASE field 1166
IFCID144 DD *(continued)*
LOGRBA field 1166
PAGESET field 1166
STATEMENT ID field 1166
TABLE OBID field 1166
IFCID145 DD 1166
ACCESS OBJECT field 1168
DATABASE field 1167
HOST OPTIONS field 1167
ISOLATION field 1167
LOCATION NAME field 1167
PKG COLLCT ID field 1167
PROGRAM NAME field 1167
SQL TEXT field 1167
STATEMENT ID field 1167
STMT# field 1167
TABLE OBID field 1167
TIME field 1167
TYPE field 1167
IFCID145 DDThe access control schema name.
ACCESS SCHEMA field 1168
IFCID269 DD 1168
CONNECTION TYPE field 1168
ENCRYPTION field 1169
JOB NAME field 1169
OBJECT OWNER field 1169
PROFILE NAME field 1169
REUSE AUTHID field 1169
ROLE ASSOCIATED field 1169
SECURITY LABEL field 1169
SERVAUTH NAME field 1169
SQLCODE field 1168
STATUS field 1168
SYSTEM AUTHID USED field 1169
TCP/IP ADDRESS field 1169
TRUSTED CONTEXT NAME field 1168
USER ROLE field 1169
IFCID270 DD 1170
SQL STATEMENT field 1170
SQL STMT LENGTH field 1170
SQLCODE field 1170
STATEMENT TYPE field 1170
IFCID350 DD 1170
HOST LANG field 1171
OPTIONS field 1171
SOURCE CCSID field 1171
SQL LENGTH field 1171
SQL SEGMENT field 1171
SQL STATEMENT field 1171
SQL STATEMENT ID field 1171
SQL STATEMENT TYPE field 1171
IFCID361 DD 1172
AUTHORITY TYPE field 1172
OBJECT TYPE field 1175
OTHER OBJECT field 1175
PRIVILEGE CHECKED field 1172
ROLE or AUTHID field 1172
SOURCE OBJECT field 1175
SOURCE QUALIFIER field 1174
SQL LENGTH field 1175
SQL STATEMENT field 1175
TARGET OBJECT field 1175
TARGET QUALIFIER field 1175
IFCID362 DD 1176
AUDIT POLICY NAME field 1177
CHECKING CATEGORY field 1176
COLLECTION ID field 1177

IFCID362 DD *(continued)*
CONTEXT CATEGORY field 1176
DATABASE NAME field 1177
DB2 START field 1177
DBADMIN CATEGORY field 1177
EXECUTE CATEGORY field 1176
LIKE TABLE # field 1177
LIKE TABLES field 1177
LIKE TABLES TRACED field 1177
OBJECT TYPE field 1177
OBJMAINT CATEGORY field 1176
REASON CODE field 1176
SECMAINT CATEGORY field 1176
STATUS field 1176
SYSADMIN CATEGORY field 1177
TABLE NAME field 1177
TABLE SCHEMA NAME field 1177
TYPE field 1176
VALIDATE CATEGORY field 1176
IGNOREFIELDS, option of LOAD utility 282
image copy
cataloging 153, 197
conditional, specifying 174
COPY utility 139
copying 191
COPYTOCOPY utility 191
data set, finding size 153
data sets 175
deleting all 391
FlashCopy 163
full
description 139
making 144, 159
incremental
conditions 161
copying 200
description 139
making 160
merging 373
performance advantage 160
list of objects 167
making after loading a table 353
making in parallel 139
multiple, making 161
obtaining information about 174
putting on tape 177, 203
IMS DPROP 330
IN predicate 563, 836
in-abort state 902
in-commit state 902
INCLUDE, option of LISTDEF utility 223, 232
inconsistent data indicator, resetting 675
INCRCOPY
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
INCURSOR
option of LOAD PART 282
option of LOAD utility 253
INDDN
option of LOAD PART 282
option of LOAD utility 253
INDEREFLIMIT option of REORG TABLESPACE utility 563
index
building during LOAD 340
checking 109, 357
determining when to reorganize 539
naming convention xvii
index *(continued)*
organization 539
REBUILD INDEX utility 427
rebuilding in parallel 447
rebuilt, recoverability 452
version numbers, recycling 358
INDEX
option of CHECK INDEX utility 111
option of COPY utility 144
option of COPYTOCOPY utility 194
option of LISTDEF utility 223
option of MODIFY STATISTICS utility 400
option of REORG INDEX utility 518
option of REPAIR utility
LEVELID statement 665
LOCATE statement 673
SET statement 668
option of REPORT utility 696
option of RUNSTATS utility 744, 754
INDEX ALL, option of REPORT utility 696
INDEX NONE, option of REPORT utility 696
index partitions, rebuilding 445
index space
recovering 427
index space status, resetting 686
INDEX
option of RECOVER utility 463
option of REORG TABLESPACE utility 563
INDEXDEFER
option of LOAD utility 253
indexes
copying 171
INDEXSPACE
option of COPY utility 144
option of COPYTOCOPY utility 194
option of LISTDEF utility 223
option of MODIFY STATISTICS utility 400
option of REBUILD INDEX utility 431
option of RECOVER utility 463
option of REORG INDEX utility 518
option of REPAIR utility
SET statement 668
option of REPAIR utility for LEVELID statement 665
option of REPORT utility 696
INDEXSPACES, option of LISTDEF utility 223
indoubt state 902
INDSN, option of DSNU CLIST command 36
inflight state 902
informational COPY-pending (ICOPY) status
COPY utility 144
description 1108
resetting 139, 175, 1108
informational referential constraints, LOAD utility 245
INLCOPY
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
inline COPY
base table space 350
creating with LOAD utility 332
creating with REORG TABLESPACE utility 629
inline statistics
collecting during LOAD 349
input fields, specifying 339
INPUT, option of CATENFM utility 70
INSTANCE, option of DIAGNOSE utility 211, 214
INTEGER
option of LOAD utility 282

INTEGER *(continued)*
option of UNLOAD utility 836
INTEGER EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
Interactive System Productivity Facility (ISPF) 29
INTO TABLE, option of LOAD utility 279
invalid LOB 102
invalid SQL terminator characters 1124
invalidated packages
identifying 989
invalidated plans and packages
identifying 78
ISPF (Interactive System Productivity Facility), utilities panels 29
ITEMERROR, option of OPTIONS statement 408

J

JCL (job control language)
COPYTOCOPY utility 200
DSNUPROC utility 34
JCL PARM statement 408
job control language 159
JOB statement, built by CLIST 40

K

KEEPDICTIONARY
option of LOAD PART 282
option of LOAD utility 253, 328
option of REORG TABLESPACE utility 328, 563
key
calculating, LOAD utility 304
foreign, LOAD operation 326
length
maximum 1025
primary, LOAD operation 326
KEY
option of OPTIONS utility 408
option of REPAIR utility on LOCATE statement 671
KEYCARD
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of RUNSTATS utility 744, 754

L

labeled-duration expression 563
LARGE
option of DSN1COMP utility 943
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
large partitioned table spaces, RUNSTATS utility 770
LAST
option of MODIFY RECOVERY utility 387
LEAFDISTLIMIT, option of REORG INDEX utility 518
LEAFLIM, option of DSN1COMP utility 943
LEAST, option of RUNSTATS utility 744, 754
LENGTH, option of REPAIR utility 678
level identifier, resetting 665
LEVELID, option of REPAIR utility 665
LIB, option of DSNU CLIST command 36
LIB, option of DSNUPROC utility 42
library of LISTDEF statements 236
LIKE predicate 563, 836
limit
option of TEMPLATE statement 793
LIMIT, option of UNLOAD utility 836
limits, DB2 1025
LIST
option of CHECK INDEX utility 111
option of COPY utility 144
option of COPYTOCOPY utility 194
option of LISTDEF utility 223
option of MERGECOPY utility 375
option of MODIFY RECOVERY utility 387
option of MODIFY STATISTICS utility 400
option of QUIESCE utility 417
option of REBUILD INDEX utility 431
option of RECOVER utility 463
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of REPORT utility 696
option of REPORT with INDEXSPACE option 696
option of REPORT with TABLESPACE option 696
option of RUNSTATS INDEX utility 754
option of RUNSTATS TABLESPACE utility 744
option of UNLOAD utility 820
list of objects, copying 139
LISTDEF
EXCLUDE option 232
INCLUDE option 232
objects, excluding 232
objects, including 232
LISTDEF library, specifying 411
LISTDEF utility
authorization 221
catalog and directory objects, specifying 232
compatibility 231
concurrency 231
control statement
creating 232
description 232
placement 237
processing 232
COPY NO indexes, specifying 223
COPY YES indexes, specifying 223
description 221
examples 240
all objects in a database 240
ARCHIVE 244
CLONED 244
COPY YES 241
excluding objects 241
including all but one partition 241
including COPY YES indexes 241
library data set 242
lists that reference other lists 241
matching name patterns 241
partition-level lists 241
pattern-matching characters 240
related objects, including 243
RI option 243
simple list 240
using LIST 237
using with QUIESCE utility 242
execution phases 221
indexes, specifying 223
LOB indicator keywords 223
LOB objects, including 223
option descriptions 223

LISTDEF utility *(continued)*
OPTIONS, using 239
output 221
partitions, specifying 223
pattern-matching expressions
characters 232
description 232
restriction 232
using 232
previewing 236
restarting 240
restrictions 221, 232
statement library 236
syntax diagram 221
TEMPLATE, using 239
terminating 240
LISTDEFDD, option of OPTIONS statement 408
lists
objects
excluding 232
including 232
previewing 236
processing order 237
using with other utilities 237
LOAD INTO PART 319
LOAD REPLACE LOG YES 313
LOAD utility
adding more data 318
after loading 353
appending to data 253
authorization 245
auxiliary index, reorganizing after LOAD 358
BINARYXML 282
building indexes
in parallel 341
sequentially 340
catalog tables, loading 303
CHECK DATA
after LOAD RESUME 354
data sets used 354
error data sets 354
running 354
sort data sets 354
compatibility 310
compressing data 328
concatenating records 253
concurrent access to data, setting 253
cross loader 331
cursors
identifying 253, 282
preparing to use 303
data conversion 338
data sets needed 304
data type compatibility 338
data type, specifying 282
data with referential constraints 326
default values, setting criteria for 282
defects, calculating number 304
DEFINE NO table space, consequences 319
deleting all data 319
delimited file format
acceptable data types 323
restrictions 323
specifying 253
delimited files 323
delimiters 323
description 245
LOAD utility *(continued)*
discard data set
declaring 253
maximum number of records 253
discarded rows, inline statistics 349
duplicate keys, effects 313
dynamic SQL 331
ENFORCE NO
actions to take 354
consequences 326
enforcing constraints 253
error work data set, specifying 253
error, calculating 304
examples 359
CHECK DATA 354
CHECK DATA after LOAD RESUME 354
concatenating records 363
CONTINUEIF 363
COPYDDN 366
CURSOR 370
data 360, 361, 369
declared cursors 370
default values, loading 363
DEFAULTIF 363
DELIMITED 362
delimited files 362
ENFORCE CONSTRAINTS 364
ENFORCE NO 364
field positions, specifying 359
inline copies, creating 366
KEEPDICTIONARY 328
loading 371, 372
loading by partition 319
LOBs 371
null values, loading 363
NULLIF 363
NUMRECS, specifying for multiple tables 360
NUMRECS, specifying for partitions 370
PARALLEL 372
parallel index build 365
PART 360
partition parallelism 369, 370
POSITION 359
referential constraints 364
REPLACE 360
replace table in single-table table space 313
replace tables in multi-table table space 313
replacing data in a given partition 360
selected records, loading 360
SORTKEYS 365
STATISTICS 367
statistics, collecting 367
Unicode input, loading 368
UNICODE option 368
EXEC SQL statements 331
exit procedure 345
extracted keys, calculating number 304
failed job, recovering 357
field length
defaults 282
determining 282
field names, specifying 282
field position, specifying 282
field specifications 282
FlashCopy 333
FlashCopy image copies, overview 163

LOAD utility *(continued)*
foreign keys
calculating 304
invalid values 326
format, specifying 253
free space 343
identity columns 316
informational referential constraints 245
inline copy 350
inline COPY 332
inline statistics, collecting 349
input data set, specifying 253
input data, preparing 303
input fields, specifying 339
into-table spec 279
KEEPDICTIONARY option 328
keys
calculating 304
LOAD INTO TABLE options 282
loading data from DL/I 330
LOB column 345
LOG, using on LOB table space 346
LOG, using on XML table space 348
logging 253
map, calculating 304
multilevel security restriction on REPLACE option 245
multiple tables, loading 279
null values, setting criteria for 282
option descriptions 253, 282
ordering records 313
output 245
parallel index build
data sets used 341
sort subtasks 341
sort work file, estimating size 341
partitions
copying 353
loading 282, 319
performance recommendations 334
preprocessing 303
primary key
duplicate values 326
missing values 326
REBUILD-pending status 344
resetting 354
RECOVER-pending status 344
recovering failed job 357
recycling version numbers 358
referential constraints 326
REORG-pending status
loading data in 344
REPLACE option 313
replacing data 253
restarting 350
restricted status 353
restrictive states, compatibility 313
RESUME YES SHRLEVEL CHANGE, without logging 348
reusing data sets 253
row change timestamp columns 316
row selection criteria 282
ROWID columns 316, 345
skipping fields 282
sort program data sets, device type 253
sort work file, specifying 253
SORTKEYS NO 312
statistics, gathering 253
syntax diagram 248
LOAD utility *(continued)*
table space, copying 353
temporal table columns 316
terminating 350
Unicode data 253
variable-length data 313
work data sets
declaring 253
estimating size 304
XML column 347
loading
catalog tables 303
data
DL/I 330
dynamic SQL 331
generated by REORG UNLOAD EXTERNAL 316
generated by UNLOAD 316
large amounts 245, 319
referential constraints 326
using a cursor, preparations 303
partition-by-growth 322
partitions 319
variable-length data 313
XML data 322
LOB
option of CHECK LOB utility 129
option of DSN1COPY utility 956
violations, resolving 135
LOB (large object)
checking 82
invalid 102
missing 102
option of DSN1PRNT utility 1001
option of LISTDEF utility 223
orphan 102
out-of-synch 102
recovering 493
LOB column
checking data 91
definitions, completing 91
errors 102
loading 345
LOB table space
copying 191
LOAD LOG 346
REORG LOG 346
reorganizing 639
LOBERROR INVALIDATE, option of CHECK DATA utility 102
LOBERROR REPORT, option of CHECK DATA utility 102
LOBERROR, option of CHECK DATA utility 82
LOCALSITE
option of RECOVER utility 463
option of REPORT utility 696
LOCATE INDEX statement of REPAIR utility 673
LOCATE INDEXSPACE statement of REPAIR utility 673
LOCATE statement of REPAIR utility 670
LOCATE TABLESPACE statement of REPAIR utility 671
location name, naming convention xvii
LOCATION, option of DSNJU003 utility 902
locking
BACKUP SYSTEM utility 64
CATENFM utility 71
CATMAINT utility 76
CHECK DATA utility 96
CHECK INDEX utility 117
CHECK LOB utility 134

locking *(continued)*
COPY utility 156
COPYTOCOPY utility 199
DIAGNOSE utility 213
EXEC SQL utility 219
LISTDEF utility 231
LOAD utility 310
MERGECOPY utility 378
MODIFY RECOVERY utility 391
MODIFY STATISTICS utility 402
OPTIONS utility 411
QUIESCE utility 419
REBUILD INDEX utility 442
RECOVER utility 472
REORG INDEX utility 537
REORG TABLESPACE utility 612
REPAIR utility 682
REPORT utility 699
RUNSTATS utility 764
STOSPACE utility 785
TEMPLATE utility 806
UNLOAD utility 858
utilities access description 47
log
active
data set status 935
printing available data sets 923
backward recovery 902
command history, printing 923
data set
active, renaming 918
archive, renaming 919
printing map 923
printing names 923
forward recovery 902
record structure, types 982
truncation 919
utilities
DSNJU003 (change log inventory) 897
DSNJU004 (print log map) 923
LOG
option of LOAD utility 253
option of REPAIR utility 665
log copy pools
system-level backups 65
log data sets with errors, deleting 915
logical partition, checking 119
logical unit name, naming convention xvii
LOGLIMIT
option of MODIFY RECOVERY utility 387
LOGONLY
option of RECOVER utility 463
option of RESTORE SYSTEM utility 729
LOGRANGES, option of RECOVER utility 463
logs
log copy pools, backups 65
LONGLOG
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
LPL status 1103
LRSNEND option of DSN1LOGP utility 982
LRSNSTART, option of DSN1LOGP utility 982
LUNAME, option of DSNJU003 utility 902
LUWID option of DSN1LOGP utility 982

M

MAP
option of REPAIR utility 678
map, calculating, LOAD utility 304
MAPDDN, option of LOAD utility 253
MAPPINGTABLE, option of REORG TABLESPACE utility 563
MAXERR, option of UNLOAD utility 820
MAXPRIME, option of TEMPLATE statement 793
MAXRO
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
MAXROWS, option of DSN1COMP utility 943
MB, option of TEMPLATE statement 793
media failure
resolving 136
member name, naming convention xvii
MEMBER option of DSNJU004 utility 925
MEMBERID, option of DSNJU003 utility 902
MERGECOPY utility
authorization 373
compatibility 378
COPY utility, when to use 380
data sets needed 377
DBD01 373, 375
description 373
different types, merging restrictions 380
directory table spaces 373
examples
merged full image copy 382, 383
merged incremental copy 381, 382
NEWCOPY NO 381, 382
NEWCOPY YES 382, 383
TEMPLATE 382
full image copy, merging with increment image copies 375
individual data sets 380
lists, using 375
LOG information, deleting 380
LOG RBA inconsistencies, avoiding 380
NEWCOPY option 379
online copies, merging 379
option descriptions 375
output 373
output data set
local, specifying 375, 377
remote, specifying 375, 377
partitions, merging copies 375
phases of execution 373
restarting 381
restrictions 373
syntax diagram 374
SYSCOPY 373, 375
SYSUTILX 373, 375
temporary data set, specifying 375, 377
terminating 381
type of copy, specifying 379
work data set, specifying 377
message
DSNU command 40
MERGECOPY utility 375
MODIFY RECOVERY utility 385
QUIESCE utility 415
RECOVER utility 457
REORG INDEX utility 513
MESSAGE, option of DIAGNOSE utility 211

MGMTCLAS, option of TEMPLATE statement 793
missing LOB 102
MIXED
  option of LOAD utility 282
  option of LOAD utility for CHAR 282
mixed volume IDs
  copying 144
MIXED, option of LOAD utility for VARCHAR 282
MODELDCB, option of TEMPLATE statement 793
MODIFY RECOVERY utility
  age criteria 387
  authorization 385
  compatibility 391
  copies, deleting 391
  data sets needed 390
  date criteria 387
  DBD, reclaiming space 393
  description 385
  examples 395
    AGE 395
    CLONE 397
    DATE 395
    DELETE 395, 396
    deleting all SYSCOPY records 396
    deleting SYSCOPY records by age 395
    deleting SYSCOPY records by date 395
    DSNUM 395
    partitions 395
    RETAIN 396
  GDG limit 387
  lists, using 387
  log limit 387
  option descriptions 387
  partitions, processing 387
  phases of execution 385
  recent records 387
  records, deleting 387
  records, retaining 387
  RECOVER-pending status, restriction 390
  recovery index rows, deleting 391
  REORG after adding column, improving performance 393
  restarting 394
  syntax diagram 387
  SYSCOPY records, viewing 390
  SYSCOPY, deleting rows 391
  SYSLGRNX 390
  SYSLGRNX, deleting rows 391
  terminating 394
  version numbers, recycling 394
MODIFY STATISTICS utility
  authorization 399
  compatibility 402
  data sets needed 402
  description 399
  examples 404
    ACCESSPATH 404
    AGE 404
    DATE 404
    deleting access path records by date 404
    deleting history records by age 404
    deleting index statistics 405
    deleting space statistics records by age 404
    SPACE 404
  lists, using 400
  option descriptions 400
  output 399
  restarting 403
MODIFY STATISTICS utility *(continued)*
  statistics history, deleting 403
  syntax diagram 400
  terminating 403
monitoring
  index organization 539
  table space organization 540, 617
  utility status 47
MOST, option of RUNSTATS utility 744, 754
multilevel security with row-level granularity
  authorization restrictions for utilities 7
  LOAD REPLACE authorization restrictions 245
  REORG TABLESPACE authorization restrictions 551
  UNLOAD authorization restrictions 817

N

naming convention, variables in command syntax xvii
NBRSECND, option of TEMPLATE statement 793
NEAROFFPOSF column of SYSINDEXPART catalog table
  catalog query to retrieve value for 617
new-function mode, converting to 71
NEWCAT, option of DSNJU003 utility 902
NEWCOPY, option of MERGECOPY utility 375
NEWLOG
  option of DSNJU003 utility 902
  statement 913
NGENERIC, option of DSNJU003 utility 902
NOALIAS, option of DSNJU003 utility 902
NOAREORPENDSTAR, option of REPAIR utility 668
NOAUXCHKP, option of REPAIR utility 668
NOAUXWARN, option of REPAIR utility 668
NOCHECKPEND, option of REPAIR utility 668
NOCOPYPEND
  option of LOAD utility 253
  option of REPAIR utility 668
NODUMPS, option of DIAGNOSE utility 211
NOPAD
  option of REORG TABLESPACE utility 563
  option of UNLOAD utility 820
NOPASSWD, option of DSNJU003 utility 902
NOPRO
  option of REPAIR utility 668
NORBDPEND, option of REPAIR utility 668
NORCVRPEND, option of REPAIR utility 668
normal-termination, option of TEMPLATE utility 793
NOSUBS
  option of LOAD utility 253
  option of UNLOAD utility 820
NOSYSREC, option of REORG TABLESPACE utility
  LOG
    option of REORG TABLESPACE utility 563
  REORG TABLESPACE utility
    logging, specifying 563
not sign, problems with 563
NULL predicate 563, 836
NULLIF, option of LOAD utility 282
NUMCOLS
  option of LOAD STATISTICS 253
  option of REBUILD INDEX utility 431
  option of REORG INDEX utility 518
  option of RUNSTATS utility 744, 754
NUMPARTS
  option of DSN1COMP utility 943
  option of DSN1COPY utility 956
  option of DSN1PRNT utility 1001

NUMQUANTILES
option of RUNSTATS utility 744, 754

O

OBID, option of DSN1LOGP utility 982
OBIDXLAT, option of DSN1COPY utility 956
object lists
adding related objects 232
creating 221
object status
advisory, resetting 1103
restrictive, resetting 1103
OBJECT, option of REPAIR utility 665
OFF, option of OPTIONS statement 408
OFFLRBA, option of DSNJU003 utility 902
OFFPOSLIMIT, option of REORG TABLESPACE utility 563
OFFSET
option of DSN1LOGP utility 982
option of REPAIR utility
DUMP statement 678
REPLACE statement 675
VERIFY statement 674
OLDEST_VERSION column, updating 394
online copies, merging 379
online utilities 17
description 3
invoking 17
option description, example 22
option of LOAD utility
FLASHCOPY 253
OPTIONS utility
altering return codes 412
authorization 407
compatibility 411
concurrency 411
description 407
errors, handling 408
examples 412
checking syntax 412
COPY 413
EVENT 413
forcing return code 0 413
ITEMERROR 413
LISTDEF 412
LISTDEF definition libraries 413
LISTDEFDD 413
MODIFY RECOVERY 413
PREVIEW 412
SKIP 413
TEMPLATE 412
TEMPLATE definition libraries 413
TEMPLATEDD 413
execution phases 407
LISTDEF definition library, specifying 408
option descriptions 408
output 407
PREVIEW with LISTDEF 408
PREVIEW with TEMPLATE 408
restarting 412
syntax diagram 407
TEMPLATE definition library, specifying 408
terminating 412
orphan LOB 102
out-of-synch LOB 102
OUTDDN, option of REPAIR utility 679
owner, creator, and schema
renaming 76
ownership of objects
changing from an authorization ID to a role 77

P

page
checking 144
damaged, repairing 686
recovering 481
size, relationship to number of pages 1001
PAGE
option of DSN1LOGP utility 982
option of RECOVER utility 463
option of REPAIR utility on LOCATE statement 671
PAGE option
RECOVER utility 481
REPAIR utility 673
page set REBUILD-pending (PSRBD) status
description 451, 1109
resetting 451, 1109
PAGES, option of REPAIR utility 678
PAGESIZE
option of DSN1COMP utility 943
option of DSN1COPY utility 956
option of DSN1PRNT utility 1001
panel
Control Statement Data Set Names 29
Data Set Names 29
DB2 Utilities 29
PARALLEL
option of COPY utility 139, 144
option of LOAD utility 253
option of RECOVER utility 463
parallel index build 447
parsing rules, utility control statements 22, 889
PART
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of LOAD utility 282, 319
option of QUIESCE utility 417
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of REPAIR utility
LOCATE INDEX and LOCATE INDEXSPACE statements 673
LOCATE TABLESPACE statement 671
SET TABLESPACE and SETINDEX options 668
option of REPAIR utility for LEVELID 665
option of RUNSTATS utility 744, 754
option of UNLOAD utility 820, 860
partition-by-growth table space
loading 322
partition-by-growth table spaces, rebuilding 446
partition-by-growth table spaces, reorganizing 637
partition, copying 160
partitioned table space
loading 319
replacing a partition 319
unloading 860
partitioned table spaces, reorganizing 637
partitions
concatenating copies with UNLOAD utility 864
rebalancing with REORG 628
redistributing 628

PARTLEVEL, option of LISTDEF utility 223
PASSWORD, option of DSNJU003 utility 902
pattern-matching characters, LISTDEF 232
patterns
  advanced information 563, 836
PCTFREE, option of DSN1COMP utility 943
PCTPRIME, option of TEMPLATE statement 793
pending status, resetting 1103
performance
  affected by
    I/O activity 617
    table space organization 617
  COPY utility 176
  LOAD utility, improving 334
  monitoring with the STOSPACE utility 785
  RECOVER utility 502
  REORG INDEX utility, improving 543
  REORG TABLESPACE utility, improving 631
Persistent Read Only (PRO) restricted status
  description 1108
  resetting
    for a table space partition 1108
phase restart, description 52
phases of execution
  BACKUP SYSTEM utility 59
  CHECK DATA utility 79
  CHECK INDEX utility 109
  CHECK LOB utility 127
  COPY utility 139
  COPYTOCOPY utility 191
  description 47
  EXEC SQL utility 217
  LISTDEF utility 221
  LOAD utility 245
  MERGECOPY utility 373
  MODIFY RECOVERY utility 385
  MODIFY STATISTICS utility 399
  OPTIONS utility 407
  QUIESCE utility 415
  REBUILD INDEX utility 427
  RECOVER utility 457
  REORG INDEX utility 513
  REORG TABLESPACE utility 551
  REPAIR utility 663
  REPORT utility 693
  RESTORE SYSTEM utility 727
  RUNSTATS utility 737
  STOSPACE utility 783
  TEMPLATE utility 789
  UNLOAD utility 817
  utilities
    CATENFM 69
PIECESIZ
  option of DSN1COPY utility 956
  option of DSN1PRNT utility 1001
point-in-time recovery
  backout 494
  for catalog and directory objects 491
  options 463
  performing 494
PORT, option of DSNJU003 utility 902
POSITION
  option of LOAD utility 282
  option of UNLOAD utility 836
predicate
  basic 563
  BETWEEN 563
predicate *(continued)*
  IN 563
  LIKE 563
  NULL 563
  overview 563
predicates
  basic 836
  BETWEEN 836
  IN 836
  LIKE 836
  NULL 836
PREFORMAT
  option of LOAD PART 282
  option of LOAD utility 253
  option of REORG INDEX utility 518
  option of REORG TABLESPACE utility 563
preformatting active logs
  data sets required 895
  description 895
  example 896
  output 896
PRESERVE WHITESPACE
  option of LOAD utility 282
PRESORTED
  option of LOAD utility 253
PREVIEW
  option of OPTIONS utility 408
  using with LISTDEF utility 236
preview mode 411
PREVIEW mode, executing utilities in 806, 807
PRINT
  option of DSN1COPY utility 956
  option of DSN1PRNT utility 1001
print log map utility (DSNJU004)
  JCL requirements 923
  SYSIN stream parsing 923
privileges
  utilities 7
PRO
  option of REPAIR utility 668
product-sensitive programming information, described 1211
programming interface information, described 1211
PSPI symbols 1211
PUNCHDDN
  option of CHECK DATA utility 82
  option of CHECK LOB utility 129
  option of REORG TABLESPACE utility 563
  option of UNLOAD utility 820
PUNCHDSN, option of DSNU CLIST command 36

Q

qualifier-name, naming convention xvii
QUIESCE
  before running 419
quiesce point, establishing 415
QUIESCE utility
  authorization 415
  catalog and directory objects 421
  compatibility 419
  creating point of consistency for the catalog and directory 492
  data sets needed 419
  description 415
  examples
    CLONE 426
    list 424

QUIESCE utility *(continued)*
examples *(continued)*
quiesce point for three table spaces 424
table space set 425
WRITE NO 425
history record, printing 923
lists, using 417
option descriptions 417
output 415
partitions 417
phases of execution 415
quiesce point, establishing 421
recovery preparations 415
restarting 423
restrictive states, compatibility 422
syntax diagram 416
table space set 417
table space, specifying 417
terminating 423
write to disk, failure 423
writing changed pages to disk 417

R

RBA (relative byte address), range printed by print log map 926
RBAEND, option of DSN1LOGP utility 982
RBASTART, option of DSN1LOGP utility 982
RBDP 1109
RBDP (REBUILD-pending) status
description 451, 505
resetting 505
RBDP* (REBUILD-pending star) status, resetting 451
RC0, option of OPTIONS statement 408
RC4, option of OPTIONS statement 408
RC8, option of OPTIONS statement 408
RCPYDSN1, option of DSNU CLIST command 36
RCPYDSN2, option of DSNU CLIST command 36
real-time statistics
data processing 1201
stored procedure 1048, 1069
used by utilities 1201
REAL, option of UNLOAD utility 836
REBALANCE, option of REORG TABLESPACE utility 563
rebinding, recommended after LOAD 349
REBUILD INDEX utility
access, specifying 445
authorization 427
Before running 440
building indexes in parallel 447
catalog indexes 452
compatibility 442
data sets needed 440
description 427
DRAIN_WAIT, when to use 446
dynamic sort and SORTDATA allocation, overriding 447
effects 454
examples 454
all indexes in a table space, rebuilding 455
CLONE 456
index partitions, rebuilding 454
inline statistics 456
multiple partitions, rebuilding 454
partitions, rebuilding all 455
restrictive states, condition 456
SHRLEVEL CHANGE 456
single index, rebuilding 454
REBUILD INDEX utility *(continued)*
FlashCopy 452
FlashCopy image copies, overview 163
index partitions 445
option descriptions 431
partition-by-growth table spaces 446
performance recommendations 446
phases of execution 427
REBUILD-pending status, resetting 451
recoverability of rebuilt index 452
recycling version numbers 454
restarting 453
several indexes
performance 446
SHRLEVEL CHANGE
log processing 445
when to use 446
SHRLEVEL option 445
slow log processing, operator actions 445
sort subtasks for parallel build 447
sort subtasks for parallel index build, determining number 447
sort work file size 447
syntax diagram 428
terminating 453
work data sets, calculating size 440
REBUILD-pending (RBDP) status
description 451, 1109
resetting 505, 1109
set by LOAD utility 354
REBUILD-pending star (RBDP*) status, resetting 451
REBUILD, option of REPAIR utility 679
RECDS, option of DSNU CLIST command 36
records, loaded, ordering 313
RECOVER
before running 471
effects 483
RECOVER utility
authorization 457
backout
point-in-time recovery 494
catalog and directory objects 484
catalog table spaces, recovering 484
CHECK-pending status, resetting 494
compatibility 472
compressed data, recovering 494
concurrent copies, improving recovery performance 463
damaged media, avoiding 507
data sets needed 472
description 457
DFSMShsm data sets 503
effects of running 508
error range, recovering 482
examples 509
CLONE 511
concurrent copies 510
CURRENTCOPYONLY 510
different tape devices 510
DSNUM 477, 509
error range 482
index image copy, recovering to 510
last image copy, recovering to 509
LIST 511
list of objects, recovering in parallel 510
list of objects, recovering to point in time 511
LRSN, recovering to 509
multiple table spaces 477

RECOVER utility *(continued)*
examples *(continued)*
PARALLEL 510
partition, recovering 509
partitions 477
point-in-time recovery 509
RESTOREBEFORE 511
single table space 477
table space, recovering 509
TAPEUNITS 510
TOLASTCOPY 509
TOLASTFULLCOPY 510
TOLOGPOINT 509
TORBA 477
fallback 506
FlashCopy 480
hierarchy of dependencies 489
incremental image copies 479
indexes
REBUILD-pending status 508
input data sets 472
JES3 environment 505
lists of objects 478
lists, using 463
LOB data 493
LOGAPPLY phase, optimizing 503
mixed volume IDs 457
non-DB2 data sets 483
objects accessed 489
option descriptions 463
order of recovery 484
output 457
pages, recovering 463, 481
parallel recovery 463, 478
partitions, recovering 463, 479
performance recommendations 502
phases of execution 457
point-in-time recovery
backout 494
for catalog and directory objects 491
planning for 494
RBA, recovering to 463
rebalancing partitions with REORG 494
REBUILD-pending status 457
recovery status 494
restarting 507
restriction 457
skipping SYSLGRNX during LOGAPPLY phase 463
specific data set, skipping 502
syntax diagram 460
table space sets 457
TABLESPACE option 175
tape mounts, retaining 507
terminating 507
RECOVER-pending (RECP) status
description 505, 1110
resetting 354, 505, 1110
recovery
backout 494
catalog objects 484
compressed data 494
consistency, ensuring 494
data set, partition 479
database
FlashCopy image copies 163
LOB table space 175
REBUILD INDEX utility 427
recovery *(continued)*
database *(continued)*
RECOVER utility 457
REORG makes image copies invalid 159
directory objects 484
error range 482
FlashCopy image copies 480
image copies 506
JES3 environment 505
log copy pool backups 65
page 481
partial 494
preparing for with copies 175
table space
description 477
multiple spaces 477
recovery base 476
recovery information
where it is stored 489
recovery information, reporting 696
recovery log
backward 902
forward 902
recovery point of consistency
creating for the catalog and directory 492
RECOVERY, option of REPORT utility 696
RECOVERYDDN
option of COPY utility 144
option of COPYTOCOPY utility 194
option of LOAD utility 253, 332
option of MERGECOPY utility 375
option of REORG TABLESPACE utility 563, 629
RECOVERYSITE
option of RECOVER utility 463
option of REPORT utility 696
RECP 354, 1110
referential constraint
loading data 326
violations, correcting 328
REFP 1111
REFRESH-pending (REFP) status
description 1111
resetting 1111
remote site recovery 161
REORG INDEX
before running 532
REORG INDEX utility
access, allowing 518
access, specifying 540
authorization 513
catalog updates 546
CHECK-pending status, compatibility 532
compatibility 537
data set
shadow, determining name 535
data sets
definitions, changing 533
needed 533
shadow, estimating size 535
unload, specifying 518
user-managed 535
data-sharing considerations 532
description 513
drain behavior, specifying 518
DRAIN_WAIT, when to use 543
examples 547
CLONE 549

REORG INDEX utility *(continued)*
examples *(continued)*
FlashCopy 549
HISTORY 548
LIST 548
MAXRO 548
OPTIONS 548
REPORT 548
SHRLEVEL 548
single index 547
STATISTICS 548
TEMPLATE 548
UNLOAD PAUSE 547
UPDATE 548
WORKDDN 548
fallback recovery, considerations 532
FlashCopy 542
FlashCopy image copies, overview 163
inline statistics
gathering 518
reporting 518
interrupting 543
lists, using 518
long logs, actions for 518
no action 518
option descriptions 518
output 513, 546
partitions, specifying 518
performance 543
phases of execution 513
preformatting pages 518
REBUILD-pending status, compatibility 532
RECOVER-pending status, compatibility 532
region size 532
report only 518
restart-pending status, compatibility with SHRELEVEL CHANGE 532
restarting 545
retries, specifying maximum number 518
shadow data sets, defining 535
shadow objects 535
SHRLEVEL CHANGE
log processing 540
when to use 543
SHRLEVEL option 540
slow log processing, operator actions 540
SWITCH phase deadline, specifying 518
syntax diagram 515
terminating 544
time for log processing, specifying 518
timeout condition, actions for 518
unloading data, action after 518
version numbers, recycling 547
versions, effect on 547
waiting time when draining for SQL 518
REORG TABLESPACE utility
access, specifying 563, 619
actions after running 647
authorization 551
building indexes in parallel 633
catalog and directory
considerations 599
determining when to reorganize 623
limitations for reorganizing 623
phases for reorganizing 623
reorganizing 623
REORG TABLESPACE utility *(continued)*
compatibility
with all other utilities 612
with CHECK-pending status 599
with REBUILD-pending status 599
with RECOVER-pending status 599
with REORG-pending status 599
compression dictionary
not building new 563
CURRENT DATE option
decrementing 563
incrementing 563
data set
copy, specifying 563
discard, specifying 563
shadow, determining name 609
data sets
shadow 609
unload 604
unload, specifying name 563
work 604
data sets needed 604
deadline for SWITCH phase, specifying 563
description 551
drain behavior, specifying 563
DRAIN_WAIT, when to use 631
DSNDB07 database, restriction 551
dynamic sort work data set allocation, overriding 627
effects 647
error in RELOAD phase 637
examples 649
CLONE 662
conditional reorganization 653
DEADLINE 651
deadline for SWITCH phase, specifying 651
determining whether to reorganize 652
discarding records 660
DRAIN_WAIT 655
draining table space 655
FlashCopy image copy 662
LONGLOG 651
mapping table, using 659
maximum processing time, specifying 651
parallel index build 650
partition, reorganizing 650
range of partitions, reorganizing 651
read-write access, allowing 650
rebalancing partitions 628
RETRY 655
RETRY_DELAY 655
sample REORG output for conditional REORG 653
sample REORG output for draining table space 655
sample REORG output that shows if REORG limits have been met 652
SCOPE PENDING 661
SHRLEVEL CHANGE 650
sort input data set, specifying 649
statistics, updating 652
table space, reorganizing 649
unload data set, specifying 649
failed job, recovering 642
fallback recovery considerations 599
FlashCopy 630
FlashCopy image copies, overview 163
indexes, building in parallel 633
inline copy 629
interrupting temporarily 627

REORG TABLESPACE utility *(continued)*
lists, using 563
LOB table space
reorganizing 639
restriction 551
log processing, specifying max time 563
long logs, action taken 563
LONGLOG action, specifying interval 563
mapping table
example 599
preventing concurrent use 599
specifying name 563
using 599
multilevel security restrictions 551
option descriptions 563
output 551, 646
partition-by-growth table spaces, reorganizing 637
partitioned table spaces, reorganizing 637
partitions in parallel 629
performance recommendations
after adding column 393
general 631
phases of execution
BUILD phase 551
LOG phase 551
RELOAD phase, description 551
RELOAD phase, error 637
SORT phase 551
SORTBLD phase 551
SWITCH phase 551
UNLOAD phase 551
UTILINIT phase 551
UTILTERM phase 551
preformatting pages 563
processing encrypted data 599
REBALANCE
restrictions 599
rebalancing partitions 628
reclaiming space from dropped tables 622
records, discarding 563
recycling version numbers 647
redistributing partitions 628
region size recommendation 599
RELOAD phase
counting records loaded 639
RELOAD phase, encountering an error in 637
reload, skipping 622
restarting 644
restriction 551
sample generated LOAD statement 563
scope, specifying 563
segmented table spaces, reorganizing 638
selection condition 563
shadow data sets, defining 609
shadow objects 609
SHRLEVEL
specifying 619
user-managed data sets with 609
SHRLEVEL CHANGE
compatibility with restart-pending status 599
log processing 619
performance implications 631
when to use 631
slow processing, operator actions 619
sort device type, specifying 563
sort program messages, specifying destination 604
REORG TABLESPACE utility *(continued)*
sort subtasks
allocation 633
determining number 633
sort work file, estimating size 633
statistics, specifying 563
syntax diagram 555
temporary data sets, specifying number 563
time to wait for drain, specifying 563
timeout, specifying action 563
timestamps
decrementing 563
incrementing 563
unload, specifying action 563
unloading data, methods of 637
versions, effect on 647
XML table space
reorganizing 640
REORG utility 328
compressing data 328
KEEPDICTIONARY option 328
REORG-pending (REORP) status
description 1111
resetting 1111
REORG, option of DSN1COMP utility 943
reorganizing
indexes 539
table spaces 540
table spaces, determining when to reorganize 617
REORP 1111
REPAIR
before running 681
REPAIR utility 668
authorization 663
before running
copying table space 681
restoring indexes 681
catalog, repairing 688
CHECK-pending status 689
commit point for LOCATE statement 671
compatibility 682
damaged page, repairing 686
data sets needed 681
DBD statement
declared temporary table 679
description 679
option descriptions 679
syntax diagram 679
using 686
declared temporary table compatibility 9, 679
DELETE statement
description 676
option descriptions 677
syntax diagram 676
DELETE statement, using with VERIFY 688
description 663
DUMP statement
description 677
option descriptions 678
syntax diagram 677
examples 689
CATALOG 691
CLONE 691
damaged data, replacing 689
DBDs 690
nonindexed row, removing 690
restrictive states, resetting 690

REPAIR utility *(continued)*
examples *(continued)*
versions, updating 691
LOCATE INDEX statement 673
LOCATE INDEXSPACE statement 673
LOCATE statement
description 670
syntax diagram 670
LOCATE TABLESPACE KEY
example messages 688
restriction for multiple-column indexes 688
LOCATE TABLESPACE statement 671
logging, specifying 665
option descriptions 665
output 663, 689
output data sets
calculating size 681
description 681
partitions 665
phases of execution 663
processing encrypted data 681
REPLACE statement
description 675
option descriptions 675
syntax diagram 675
REPLACE statement, using with VERIFY 688
resetting states, options 668
restarting 688
rows, locating by key 688
SET INDEX statement
description 668
option descriptions 668
SET INDEXSPACE statement
description 668
option descriptions 668
SET TABLESPACE statement
description 668
option descriptions 668
status, resetting 685, 686
syntax diagram 664
terminating 688
VERIFY statement
description 674
option descriptions 674
syntax diagram 674
VERIFY statement, using with REPLACE and DELETE 688
version information
updating on the same system 665
warning 681
REPLACE
option of LOAD PART 282
option of LOAD utility 253
statement of REPAIR utility
description 675
used in LOCATE block 670
replacing data in a table space 313
REPORT
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744, 754
REPORT utility
authorization 693
catalog and directory 700
compatibility 699
REPORT utility *(continued)*
data sets needed 699
description 693
examples 710
archive tables 718
recovery information for index 715
recovery information for partition 713, 716
recovery information for table space 710
referential relationships 712
TABLESPACESET 712
temporal tables 716
versioning relationships 716
option descriptions 696
output 693
phases of execution 693
RECOVERY
output 700
sample output 700
recovery information, reporting 696
restarting 700
syntax diagram 695
TABLESPACESET
output 700
sample output 700
terminating 700
REPORTONLY
option of COPY utility 144
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
REPORTONLY, option of COPY utility 174
RESET
option of DSN1COPY utility 956
option of REPAIR utility 675
resetting
DBETE status
DBET error 1107
pending status
advisory 1103
auxiliary CHECK-pending (ACHKP) 1103
CHECK-pending (CHKP) 1105
COPY-pending 1106
group buffer pool RECOVER-pending (GRECP) 1108
informational COPY-pending (ICOPY) 175, 1108
page set REBUILD-pending (PSRBD) 1109
REBUILD-pending (RBDP) 451
REBUILD-pending (RBDP), for the RECOVER utility 505
REBUILD-pending (RBDP), summary 1109
RECOVER-pending (RECP), for the RECOVER utility 505
RECOVER-pending (RECP), summary 1110
REORG-pending (REORP) 1111
restart-pending 1114
Persistent Read Only (PRO) restricted status 1108
refresh status, REFRESH-pending (REFP) 1111
warning status, auxiliary warning (AUXW) 1104
RESPORT, option of DSNJU003 utility 902
restart
conditional control record
reading 937
sample 937
restart-pending (RESTP) status
description 1114
resetting 1114
RESTART, option of DSNU CLIST command 36
restarting
performing first two phases only 902

restarting *(continued)*
problems
cannot restart REPAIR 688
cannot restart REPORT 700
utilities
BACKUP SYSTEM 66
CATMAINT 78
CHECK DATA 104
CHECK INDEX 124
CHECK LOB 136
COPY 178
creating your own JCL 56
current restart 52
data set name 52
DIAGNOSE 214
EXEC SQL 219
EXEC statement 44
JCL, updating 56
LISTDEF 240
lists 58
LOAD 350
MERGECOPY 381
methods of restart 56
MODIFY RECOVERY utility 394
MODIFY STATISTICS 403
OPTIONS 412
out-of-space condition 57
phase restart 52
QUIESCE 423
REBUILD INDEX 453
RECOVER 507
REORG INDEX 544, 545
REORG TABLESPACE 642, 644
RESTORE SYSTEM 733
RUNSTATS 770
STATISTICS keyword 52
STOSPACE 787
TEMPLATE 811
templates 57
UNLOAD 877
using DB2I 56
using the DSNU CLIST command 56
UTPROC 42
volume serial 52
restarting a utility
DSNUTILS 1033
DSNUTILU 1044
RESTORE SYSTEM utility
actions after running 734
authorization 727
compatibility 733
creating system point in time for 902
data sets needed 732
data sharing environment 733
description 727
DISPLAY UTILITY command 733
effects of running 734
examples 735
FROMDUMP 735
LOGONLY 735
LOGONLY SWITCH VCAT 735
recovering a system 735
indexes
REBUILD-pending status 734
option descriptions 729
output 727
phases of execution 727
RESTORE SYSTEM utility *(continued)*
preparation 730
restarting 733
syntax diagram 729
terminating 733
RESTOREBEFORE
option of RECOVER utility 463
RESTP 1114
restricted status
LOAD utility 353
restrictive status
resetting 685, 686, 1103
RESUME, option of LOAD PART 282
RESUME, option of LOAD utility 253
RETAIN
option of MODIFY RECOVERY utility 387
RETPD, option of TEMPLATE statement 793
RETRY
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
RETRY_DELAY
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of REBUILD INDEX utility 431
return code, altering 412
return code, CHANGELIMIT 174
REUSE
option of LOAD PART 282
option of LOAD utility 253
option of REBUILD INDEX 431
option of RECOVER utility 463
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
RI, option of LISTDEF utility 223
RID
option of DSN1LOGP utility 982
option of REPAIR utility on LOCATE statement 671
row change timestamp columns, loading 316
row format
REORG TABLESPACE, effect of 647
ROWID
option of LOAD utility 282
option of REPAIR utility on LOCATE statement 671
option of UNLOAD utility 836
ROWID columns
generating 345
loading 316, 345
ROWLIMIT, option of DSN1COMP utility 943
RSTMBR, option of DSNJU003 utility 902
running online utilities
JCL 44
RUNSTATS utility
access, specifying 744, 754
actions after running 777
after LOAD 349
aggregation of statistics, specifying 744, 754
authorization 737
catalog table spaces
processing 767
sample output 767
catalog table updates 770
COLGROUP option 737

RUNSTATS utility *(continued)*
column frequency statistics, gathering 744
column information, gathering 744
compatibility 764
data sets needed 762
description 737
device type for sort program, specifying 744, 754
directory objects 767
distribution statistics for column groups 766
examples 777
collecting distribution statistics 779
gather histogram statistics 781
generating a report 778
invalidating statements in the dynamic statement cache 780
reporting statistics only 778
updating access path statistics 778
updating all statistics 778
updating catalog and history statistics 779
updating frequency statistics 779
updating index statistics 777
updating key column statistics 779
updating statistics for a partition 779
updating statistics for a table space 778
updating statistics for several tables 778
updating statistics while allowing changes 777
updating statistics while not allowing changes 778
grouping columns 744
HISTOGRAM option 737
HISTORY option 768
index frequency statistics, gathering 744
INDEX option 737
index partitions, gathering statistics 744
index partitions, specifying 754
INDEX syntax diagram 753
key column combinations, gathering information 744
large partitioned table spaces 770
lists, using 744, 754
LOB table space, space statistics 768
option descriptions
options for RUNSTATS INDEX 754
output 737, 770
partitioned table space, updating statistics 766
phases of execution 737
preparation 761
profile syntax diagram 758
reporting information 744, 754
restarting 770
sample of columns, gathering statistics 744
SAMPLE option 744
sort work data sets, specifying number 744, 754
space statistics 768
table space partitions, gathering statistics 744
TABLESPACE option 737
TABLESPACE syntax diagram 739
terminating 770
updating catalog information 744, 754
work data sets
using for frequency statistics 767
XML table space 768
RUNTSTATS
RESET ACCESSPATH option 774

S

SAMPLE
option of LOAD STATISTICS 253
SAMPLE *(continued)*
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744
option of UNLOAD utility 836
scanning rules, utility control statements 22, 889
SCOPE
option of CHECK DATA utility 82, 99
option of COPY utility
ALL 144
PENDING 144
option of REBUILD INDEX utility 431
option of REORG TABLESPACE utility 563
SCOPE PENDING, CHECK DATA after LOAD utility 354
SECPORT, option of DSNJU003 utility 902
security 7
security, data sets 18
SEGMENT, option of DSN1COPY utility 956
segmented table space
copying 144
segmented table spaces, reorganizing 638
SELECT statement
list
maximum number of elements 1025
SYSIBM.SYSTABLESPACE, example 785
select-statement, option of EXEC SQL utility 218
SELECT, option of DSN1SDMP utility 1013
SELECT2, option of DSN1SDMP utility 1013
semicolon
embedded 1124
SET INDEX statement 668
SET INDEX statement of REPAIR utility 668
SET INDEXSPACE statement 668
SET INDEXSPACE statement of REPAIR utility 668
SET TABLESPACE statement 668
SET TABLESPACE statement of REPAIR utility 668
setting SQL terminator
DSNTIAD 1124
shadow data sets
CHECK DATA utility 94
CHECK INDEX utility 115
CHECK LOB utility 132
defining
REORG INDEX utility 535
REORG TABLESPACE utility 609
estimating size, REORG INDEX utility 535
shift-in character, LOAD utility 282
shift-out character, LOAD utility 282
shortcut keys
keyboard xvi
SHRLEVEL
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of COPY utility
CHANGE 144, 167
REFERENCE 144, 167
option of LOAD utility 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of REPAIR utility on LOCATE statement 671
option of RUNSTATS utility 744, 754
option of UNLOAD utility 820
SHRLEVEL CHANGE
option of REPAIR utility on LOCATE statement 671
SIZE, option of DSNUPROC utility 42
SKIP, option of OPTIONS statement 408

SMALLINT
option of LOAD utility 282
option of UNLOAD utility 836
SMF trace records, compressing
DSNTSMFD 1197
sort program
data sets for REORG TABLESPACE, specifying device type 563
messages from REORG TABLESPACE, specifying destination 604
SORTDATA, option of REORG TABLESPACE utility 563
SORTDEVT
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of LOAD utility 253
option of REBUILD INDEX 431
option of REORG INDEX 518
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744, 754
SORTKEYS
option of LOAD utility 253
SORTNUM
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 129
option of LOAD utility 253
option of REBUILD INDEX 431
option of REORG INDEX 518
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744, 754
SORTOUT
data set of LOAD utility, estimating size 304
space
DBD, reclaiming 393
unused, finding for nonsegmented table space 617
SPACE
AGE option of MODIFY STATISTICS utility 400
DATE, option of MODIFY STATISTICS utility 400
option of MODIFY STATISTICS utility 400
option of REORG TABLESPACE utility 563
option of TEMPLATE utility 793
SPACE column
analyzing values 786
spanned record format 863
SQL (Structured Query Language)
limits 1025
statement terminator 1124
SQL statement terminator
modifying in DSNTEP2 and DSNTEP4 1118, 1126
modifying in DSNTIAD 1124
SQL terminator, specifying in DSNTEP2 and DSNTEP4 1118, 1126
SQL terminator, specifying in DSNTIAD 1124
STACK, option of TEMPLATE statement 793
stand-alone utilities 887
control statement, creating 889
description 3
invoking 887
JCL EXEC PARM, using to specify options 888
specifying options 888
standard report header
CONNECT field 1138
CONNTYPE field 1138
CORRNAME field 1138
CORRNMBR field 1138
DESCRIPTION field 1138
standard report header *(continued)*
DESTNO field 1138
END_USER field 1138
IFCID field 1138
INSTANCE field 1138
ORIGAUTH field 1137
PLANNAME field 1138
PRIMAUTH field 1137
RECORD TIME field 1138
TCB CPU TIME field 1138
TRANSACT field 1139
WS_NAME field 1138
START TRACE command, option of DSN1SDMP utility 1013
START, option of CATENFM utility 70
STARTIME, option of DSNJU003 utility 902
STARTRBA, option of DSNJU003 utility 902
state, utility execution 47
statistics
gathering 737
real-time
stored procedure 1069
Statistics 774
STATISTICS
option of LOAD utility 253
option of REBUILD INDEX 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
statistics history
deleting specific entries 403
reasons to delete 403
statistics, space utilization and the REORG INDEX utility 540
status
CHECK-pending, resetting 354
COPY-pending, resetting 353
displaying 1103
option of TEMPLATE statement 793
page set REBUILD-pending (PSRBD) 451
REBUILD-pending (RBDP) 451
REBUILD-pending star (RBDP*) 451
status of utility
active 47
stopped 47
terminated 47
STOGROUP, option of STOSPACE utility 784
stopped status, of a utility 47
stopping, state of utility execution 47
storage group, DB2
disk space 785
storage allocated 785
STORCLAS, option of TEMPLATE statement 793
stored procedure
DSNACCOR 1048
DSNUTILS 1033
DSNUTILU 1044
real-time statistics 1048
stored procedures
DB2-supplied 1033
DSNACCOX 1033, 1069
DSNUTILS 1033
DSNUTILU 1033
real-time statistics 1069
STOSPACE utility
authorization 783
availability of objects, ensuring 785
catalog updates 785
compatibility 785
data sets needed 784

STOSPACE utility *(continued)*
description 783
examples
all storage groups, updating space values 787
one storage group, updating space values 787
several storage groups, updating space values 787
stogroup names 787
monitoring disk space for a storage group 785
option descriptions 784
output 783
phases of execution 783
restarting 787
statistical information, obtaining 785
syntax diagram 784
terminating 787
string, naming convention xvii
strings
advanced information 563, 836
STRIP
option of LOAD utility
BINARY data type 282
CHAR data type 282, 340
GRAPHIC data type 282, 340
GRAPHIC EXTERNAL data type 282
VARBINARY data type 282
VARCHAR data type 282, 340
VARGRAPHIC data type 282, 340
STRIP, option of UNLOAD utility 836
STRTLRSN, option of DSNJU003 utility 902
STTRACE, option of DSN1SDMP utility 1013
SUBMIT, option of DSNU CLIST command 36
substring notation, TEMPLATE utility 793
subsystem
backing up 59
restoring 727
subsystem parameters
DFSMSdss COPY operation with utilities 48
subsystem, naming convention xvii
SUBTYPE, option of DSN1LOGP utility 982
SUMMARY
option of DSN1LOGP utility 982
option of REPORT utility 696
switching
templates
TEMPLATE 811
syntax diagram 668
BACKUP SYSTEM utility 60
CATENFM utility 69
CATMAINT utility 73
change log inventory utility (DSNJU003) 898
CHECK DATA utility 80
CHECK INDEX utility 110
CHECK LOB utility 128
COPY utility 141
COPYTOCOPY utility 193
DIAGNOSE utility 209
DSN1COMP utility 943
DSN1COPY utility 956
DSN1LOGP utility 982
DSN1PRNT utility 1001
DSN1SDMP utility 1013
DSNADMSB 1180
DSNJU003 utility 898
DSNJU004 utility 925
DSNU CLIST command 36
DSNUTILS stored procedure 1036
DSNUTILU stored procedure 1046
syntax diagram *(continued)*
EXEC SQL utility 217
how to read xx
LISTDEF utility 221
LOAD utility 248
MERGECOPY utility 374
MODIFY RECOVERY utility 387
MODIFY STATISTICS utility 400
OPTIONS statement 407
print log map utility 925
QUIESCE utility 416
REBUILD INDEX utility 428
RECOVER utility 460
REORG INDEX utility 515
REORG TABLESPACE utility 555
REPAIR utility 664
REPORT utility 695
RESTORE SYSTEM utility 729
RUNSTATS INDEX 753
RUNSTATS profile 758
RUNSTATS TABLESPACE 739
STOSPACE utility 784
TEMPLATE statement 789
UNLOAD utility 818
SYSCOPY
directory table space, MERGECOPY restrictions 373, 375
option of DSN1LOGP utility 982
SYSCOPY, deleting rows 391
SYSDISC data set
LOAD utility, estimating size 304
SYSERR data set
LOAD utility, estimating size 304
SYSIBM.SYSCOPY
ICBACKUP column 161
ICUNIT column 161
SYSIBM.SYSLGRNX
objects recorded 491
SYSIN DD statement, built by CLIST 40
SYSLGRNX, deleting rows 391
SYSMAP data set
estimating size 304
SYSPITR, option of DSNJU003 utility 902
SYSPITRT, option of DSNJU003 utility 902
SYSPRINT DD 1178
SYSPRINT DD statement, built by CLIST 40
SYSPUNCH
using to LOAD data 316
SYSTEM
option of DSNU CLIST command 36
option of DSNUPROC utility 42
system data sets, renaming 918
system monitoring
index organization 539
table space organization 540, 617
system point in time, creating 902
system-level
backup 937
system-level backups
recovering from 474
system-level-backup 476
system, limits 1025
SYSTEMPAGES, option of COPY utility 144
SYSUT1 data set for LOAD utility, estimating size 304
SYSUTILX directory table space
MERGECOPY restrictions 373, 375
order of recovering 484

T

table
  dropping, reclaiming space 622
  exception, creating 98
  multiple, loading 279
  replacing 313
  replacing data 313
TABLE
  option of LISTDEF utility 223
  option of LOAD STATISTICS 253
  option of REORG TABLESPACE utility 563
  option of RUNSTATS utility 744
table name, naming convention xvii
table space
  checking 79
  checking multiple 107
  determining when to reorganize 540, 617
  LOAD LOG 358
  merging copies 373
  naming convention xvii
  nonsegmented, finding unused space 617
  partitioned, updating statistics 766
  REORG LOG 647
  reorganizing
    determining when to reorganize 617
    using SORTDATA option of REORG utility 617
    utilization 540
  segmented
    LOAD utility 313
  status, resetting 685
table spaces
  LOAD on NOT LOGGED, effect of 358, 647
TABLESPACE
  option of CHECK DATA utility 82
  option of CHECK INDEX utility 111
  option of CHECK LOB utility 129
  option of COPY utility 144
  option of COPYTOCOPY utility 194
  option of LISTDEF utility 223
  option of MERGECOPY utility 375
  option of MODIFY RECOVERY utility 387
  option of MODIFY STATISTICS utility 400
  option of QUIESCE utility 417
  option of REBUILD INDEX utility 431
  option of RECOVER utility 463
  option of REORG TABLESPACE utility 563
  option of REPAIR utility
    general description 665
    on LOCATE TABLESPACE statement 671
    on SET TABLESPACE and SET INDEX statements 668
  option of REPORT utility 696
  option of RUNSTATS utility 744, 754
  option of UNLOAD utility 820
TABLESPACES, option of LISTDEF utility 223
TABLESPACESET
  option of QUIESCE utility 417
  option of REPORT utility 696
TAPEUNITS
  option of COPY utility 144
  option of RECOVER utility 463
TEMPLATE library 806
TEMPLATE library, specifying 411
TEMPLATE utility
  authorization 789
  BSAM buffers, specifying number 793
  compatibility 806
TEMPLATE utility *(continued)*
  data set names
    convention for specifying 793
    creating 807
    guidelines 807
  data set size
    controlling 808
    DB2 estimates 808
    default space calculations 808
    extent allocations 808
  DD name for tape, specifying 793
  description 789
  devices
    specifying 793
    specifying number 793
  disposition of data set
    defaults for dynamically allocated data sets for new utility executions 793
    defaults for dynamically allocated data sets on RESTART 793
    specifying 793
  examples
    basic template 811
    COPY job with LISTDEF and TEMPLATE 806
    COPY job with TEMPLATE and LISTDEF 813
    creating a GDG data set 813
    GDG data set, copying to tape 814
    LOB objects, unloading 815
    specifying an expiration date 812
    specifying disposition 813
    specifying space parameters 812
    template switching 182, 815
    using default size 813
    variable substring notation 812
  expiration date for data set, specifying 793
  GDG base, specifying number of entries 793
  GDGs, working with 810
  instructions 789, 806
  model data set, specifying 793
  operations 806
  option descriptions 793
    LRECL 793
    RECFM 793
    SUBSYS 793
  output 789
  phases of execution 789
  PREVIEW mode, executing in 806, 807
  previewing data set names 806, 807
  restarting 811
  retention period for data set, specifying 793
  scope of control statement 806
  SMS data class, specifying 793
  SMS management class, specifying 793
  SMS storage class, specifying 793
  space parameters, specifying 793
  substring notation 793
  switching 811
  syntax diagram 789
  tape, working with 809
  terminating 811
  track recording technique, specifying 793
  variables
    DATE 793
    example meaningful data set name 807
    JOB 793
    OBJECT 793
    TIME 793

TEMPLATE utility *(continued)*
variables *(continued)*
using in the data set name 793
UTILITY 793
volume serial numbers, specifying 793
volumes, specifying maximum number 793
TEMPLATEDD, option of OPTIONS statement 408
temporal table columns, loading 316
TERM UTILITY command
COPY utility 178
description 51
effect on
RECOVER utility 507
rerunning UNLOAD 877
LOAD 350
terminated status, of a utility 47
terminating
MERGECOPY 381
state of utility execution 47
utilities
BACKUP SYSTEM 66
CATENFM 72
CATMAINT 78
CHECK DATA 104
CHECK INDEX 124
CHECK LOB 136
COPY 178
COPYTOCOPY 205
data sharing 51
description 51
DIAGNOSE 214
EXEC SQL 219
LISTDEF 240
LOAD 350
MODIFY RECOVERY 394
MODIFY STATISTICS 403
OPTIONS 412
QUIESCE 423
REBUILD INDEX 453
RECOVER 507
REORG INDEX 544
REORG TABLESPACE 642
REPAIR 688
REPORT 700
RESTORE SYSTEM 733
RUNSTATS 770
STOSPACE 787
TEMPLATE 811
UNLOAD 877
terminating a utility
DSNUTILS 1033
TEST, option of REPAIR utility 679
TIME EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
TIME, option of DSNJU003 utility 902
TIMEOUT
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
TIMESTAMP EXTERNAL
option of LOAD utility 282
option of UNLOAD utility 836
timestamp, BSDS 934
timestamp, incrementing and decrementing value 836
timestamps, printing system and utility 923
TOCOPY, option of RECOVER utility 463
TOKEN, option of BACKUP SYSTEM utility 61
TOLASTCOPY, option of RECOVER utility 463
TOLASTFULLCOPY option of RECOVER utility 463
TOLOGPOINT, option of RECOVER utility 463
TORBA option of RECOVER utility 463
TOSEQNO, option of RECOVER utility 463
TOVOLUME, option of RECOVER utility 463
TRACEID, option of DIAGNOSE utility 211, 214
tracing
processor use by utilities 48
TRK, option of TEMPLATE statement 793
TRTCH, option of TEMPLATE statement 793
TRUNCATE
option of LOAD utility
BINARY data type 282
CHAR data type 282, 340
GRAPHIC data type 282, 340
GRAPHIC EXTERNAL data type 282
VARBINARY data type 282
VARCHAR data type 282, 340
VARGRAPHIC data type 282, 340
trusted context
utilities 7
TYPE
option of DIAGNOSE utility 211
option of DSN1LOGP utility 982

U

UID
option of DSNU command 36
option of DSNUPROC utility 42
UNCNT, option of TEMPLATE statement 793
UNICODE
option of LOAD utility 253
option of UNLOAD utility 820
UNIT
option of DSNJU003 utility 902
option of DSNU CLIST command 36
option of TEMPLATE statement 793
unit of recovery
in-abort 902
inflight 902
unit of work
in-commit 902
indoubt, conditional restart 902
UNLDDN
option of REORG TABLESPACE utility 563
option of UNLOAD utility 820
UNLOAD
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
UNLOAD utility
64-bit floating point notation, specifying 836
access, specifying 820
ASCII format, specifying 820
authorization required 817
binary floating-point number format, specifying 836
blanks in VARBINARY fields, removing 836
blanks in VARCHAR fields, removing 836
blanks in VARGRAPHIC fields, removing 836
BLOB data type, specifying 836
BLOB strings, truncating 836
CCSID format, specifying 820
CHAR data type, specifying 836
character string representation of date, specifying 836
character string representation of time, specifying 836
character strings, truncating 836

UNLOAD utility *(continued)*
CLOB data type, specifying 836
CLOB strings, truncating 836
compatibility 858
compressed data 877
constant field, specifying 836
converting data types 867
copies, concatenating 864
data sets used 857
data type compatibility 867
data, identifying 820
DBCLOB format, specifying 836
DBCS string, truncating 836
DD name of unload data set, specifying 820
DD statement for image copy, specifying 820
decimal format, specifying 836
decimal point character, specifying for delimited formats 820
delimited files 873
delimited format, specifying 820
delimiters
column 820
string 820
description 817
EBCDIC format, specifying 820
examples 878
CLONE 883
delimited file format 882
FROMCOPY option 879
HEADER option 879
LOBs 883
partitioned table space 880
SAMPLE option 879
specifying a header 879
unloading a sample of rows 879
unloading all columns 878
unloading data from an image copy 879
unloading data in parallel 880
unloading from two tables 879
unloading LOBs 883
unloading multiple table spaces 881
unloading specific columns 878
unloading specified partitions 880, 882
using a field specification list 878
using LISTDEF 880, 881, 882
using TEMPLATE 880
field position, specifying 836
field specification errors, interpreting 877
field specifications 831
floating-point data, specifying format 820
FROM TABLE clause 864
compatibility with LIST 831
parentheses 831
FROM TABLE option descriptions 836
FROM TABLE syntax diagram 832
graphic type, specifying 836
graphic type, truncating 836
header field, specifying 836
image copies, unloading 864
image copy, specifying 820
integer format, specifying 836
internal format, specifying 820
labeled duration expression 836
lists, specifying 820
LOAD statements, generating 876
LOAD statements, specifying data set for 820
LOB data 862, 863
UNLOAD utility *(continued)*
maximum errors allowed, specifying 820
maximum number of rows to unload, specifying 836
multilevel security restrictions 817
multiple tables, unloading 831
option descriptions 820
output 817
output columns
ordering 864
selecting 864
output field position, specifying 869
output field size, specifying 869
output field types, specifying 867
output fields, determining layout 870
padding for variable length data, not using 820
partitions, identifying 820, 860
phases of execution 817
preparation 857
processing encrypted data 857
real format, specifying 836
restarting 877
ROWID type, specifying for output data 836
sampling rows 836
selection condition 836
small integer, specifying 836
source partitions, selecting 860
source tables, selecting 864
special values Infinity, sNaN, or NaN 872
STRIP option 875
substitutions, not using 820
syntax diagram 818
table space, specifying 820
terminating 877
TRUNCATE option 875
Unicode format, specifying 820
varying-length data format, specifying 836
varying-length graphic type, specifying 836
WHEN clause 836
XML data 861, 863
unloading LOB data 862
unloading partitions 860
unloading XML data 861
UPDATE
option of CATMAINT utility 74
option of LOAD STATISTICS 253
option of REBUILD INDEX utility 431
option of REORG INDEX utility 518
option of REORG TABLESPACE utility 563
option of RUNSTATS utility 744, 754
URID (unit of recovery ID), option of DSN1LOGP utility 982
utilities
authorization IDs 7
BACKUP SYSTEM
log copy pools 65
controlling 47
data set disposition 18
DSN1SMFP utility 1133
executing
DB2I 29
DSNU CLIST command 34
JCL 41, 44
problems during 47
restart 52
failure, determining cause 47
loading 5
MERGECOPY 381
mixed-release data sharing environment, operating in 6

utilities *(continued)*
monitoring 47
online 44
description 3
invoking 17
packaging 5
phase, determining 47
privileges 7
real-time statistics 1201
running concurrently 28
SMP/E jobs 5
stand-alone
description 3
invoking 887
suite
installing 5
target objects, declared temporary table 9
trusted context 7
types
BACKUP SYSTEM 59
CATENFM 69
CATMAINT 73
change log inventory (DSNJU003) 897
CHECK DATA 79
CHECK INDEX 109
CHECK LOB 127
COPY 139
COPYTOCOPY 191
DIAGNOSE 209
DSN1COMP 941
DSN1COPY 953
DSN1LOGP 979
DSN1PRNT 999
DSN1SDMP 1011
DSNJCNVB 891
DSNJCNVT 893
EXEC SQL 217
LISTDEF 221
MERGECOPY 373
MODIFY RECOVERY 385
MODIFY STATISTICS 399
OPTIONS 407
preformat active log (DSNJLOGF) 895
print log map (DSNJU004) 923
QUIESCE 415
REBUILD INDEX 427
RECOVER 457
REORG 537
REORG INDEX 513
REORG TABLESPACE 551
REPAIR 663
REPORT 693
RESTORE SYSTEM 727
RUNSTATS 737
STOSPACE 783
TEMPLATE 789
UNLOAD 817
typesA
LOAD 245
UTILITIES panel, DB2 29
utilities, processor use
tracing 48
utility control statements
creating 22
parsing rules 22
scanning rules 22
utility-id naming convention xvii
UTILITY, option of DSNU CLIST command 36
UTPRINT DD statement, built by CLIST 40
UTPROC, option of DSNUPROC utility 42

V

validation routine
LOAD utility 245
REORG TABLESPACE utility 563
VALUE
option of DSN1COPY utility 956
option of DSN1LOGP utility 982
option of DSN1PRNT utility 1001
VARBINARY
option of the LOAD utility 282
VARCHAR
data type, loading 313
option of LOAD utility 282
option of UNLOAD utility 836
VARGRAPHIC
data type, loading 313
option of LOAD utility 282
option of UNLOAD utility 836
varying-length rows, relocated to other pages, finding number of 617
VERIFY, statement of REPAIR utility 670, 674
version number management 394
LOAD utility 358
REBUILD INDEX utility 454
REORG INDEX utility 547
REORG TABLESPACE utility 647
version numbers, recycling 394
VERSION, option of REPAIR utility on LOCATE statement 671
VERSIONS, option of REPAIR utility 665
versions, REORG TABLESPACE effect on 647
violation messages 100
violations
correct 100
finding 100
VOLCNT, option of TEMPLATE statement 793
VOLUME, option of DSNU CLIST command 36
VOLUMES, option of TEMPLATE statement 793
VSAM (Virtual Storage Access Method)
used by REORG TABLESPACE 604
used by STOSPACE 785
VSAMCAT, option of DSNJU003 utility 902

W

WAIT, option of DIAGNOSE utility 211
WARNING, option of OPTIONS statement 408
WHEN
option of LOAD utility 282
option of REORG TABLESPACE utility 563
option of UNLOAD utility 836
work data sets
CHECK DATA utility 82, 92
LOAD utility 304
WORKDDN
option of CHECK DATA utility 82
option of CHECK INDEX utility 111
option of CHECK LOB utility 131
option of LOAD utility 253
option of MERGECOPY utility 375
option of REORG INDEX utility 518

WRITE, option of QUIESCE utility 417

X

XML
option of LISTDEF utility 223
option of LOAD utility 282
XML column
loading 347
XML columns
loading 322
XML data
collecing statistics 768
loading 322
RUNSTATS utility 768
XML table space
copying 170, 191
LOAD LOG 348
reorganizing 640
XMLCHECK DATA 101
XMLERROR, option of CHECK DATA utility 82

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