OS/390
Integrated Cryptographic Service Facility

Administrator's Guide

SC23-3975-05

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Note!

Before using this information and the product it supports, be sure to read the general information under Appendix D, “Notices” on page 335.

Sixth Edition (March 2000)

This is a revision of SC23-3975-04.

This edition applies to Version 2 Release 9 of the OS/390 Integrated Cryptographic Service Facility (ICSF), 5647-A01, and to all subsequent releases and modifications until otherwise indicated in new editions.

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Contents

About This Book

This book describes how to manage cryptographic keys by using the OS/390 Integrated Cryptographic Service Facility (ICSF), which is part of the OS/390 SecureWay Cryptographic Services. The OS/390 SecureWay Cryptographic Services includes the following components:

- OS/390 Integrated Cryptographic Service Facility (ICSF)
- OS/390 Open Cryptographic Services Facility (OCSF)

One of the SecureWay brand of offerings for network security, ICSF is a software product that works with the hardware cryptographic feature and the OS/390 Security Server (RACF element) to provide secure, high-speed cryptographic services in the OS/390 environment. ICSF provides the application programming interfaces by which applications request the cryptographic services. The cryptographic feature is secure, high-speed hardware that performs the actual cryptographic functions.

The Cryptographic Coprocessor Feature which includes one or two cryptographic coprocessor chips protected by tamper-detection circuitry and a cryptographic battery unit is available on the following servers:

- IBM S/390 Parallel Enterprise Server - Generation 3 with feature code 0800 plus one of the following feature codes (0801, 0802, 0803, 0804, 0805)
- IBM S/390 Multiprise 2000 with feature code 800 plus one of the following feature codes (0801, 0802, 0803, 0804, 0805)
- IBM S/390 Parallel Enterprise Server - Generation 4 or IBM S/390 Parallel Enterprise Server - Generation 5 with feature code 0800 plus one of the following feature codes (0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835)
- IBM S/390 Parallel Enterprise Server - Generation 6 with feature code 0800 plus one of the following feature codes (0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835)

The PCI Cryptographic Coprocessor is the IBM SecureWay 4758 model 2 standard PCI-bus card. It is available on the S/390 G5 Enterprise Server field upgrade and the S/390 G6 Enterprise Server field upgrade with feature code 0860 plus one of the following feature codes (0864 or 0865).

The Integrated Cryptographic Feature (ICRF) is an optional feature that consists of a tamper-resistant thermal conduction module (TCM) with a tamper-resistant cable running to the key storage unit (KSU) mounted on the processor frame. The ICRF is available on ES/9000-9021 (bipolar) processors.

OS/390 ICSF continues to support bipolar processors while extending cryptographic support to the S/390 Enterprise Servers and S/390 Multiprise. Resource Access Control Facility (RACF), an element of the OS/390 Security Server can be used to control access to cryptographic keys and functions.

ICSF enhances OS/390 security as follows:

- It ensures data privacy by encrypting and decrypting the data.

- It manages personal identification numbers (PINs).
- It ensures the integrity of data through the use of modification detection codes (MDCs), hash functions, or digital signatures.
- It ensures the privacy of cryptographic keys themselves by encrypting them under a master key or another key-encrypting key.
- It enforces DES key separation, which ensures that cryptographic keys are used only for their intended purposes.
- It enhances system availability by providing continuous operation.
- It enables the use of Rivest-Shamir-Adelman (RSA) and Digital Signature Standard (DSS) public and private keys on a multi-user, multi-application platform.
- It provides the ability to generate RSA key pairs within the secure hardware boundary of the PCI Cryptographic Coprocessor.

This book explains the basic concepts of protecting and managing the keys used in cryptographic functions. It provides step-by-step guidance for the ICSF administration tasks.

Who Should Use This Book

This book is intended for anyone who manages cryptographic keys. Usually, this person is the ICSF administrator.

The ICSF administrator performs the following major tasks:

- Entering and changing master keys
- Generating, entering, and updating cryptographic keys
- Viewing system status, which includes hardware status, installation options, installation exits, and installation services

How to Use This Book

The first three chapters of this book give you background information you need to manage cryptographic keys on ICSF.

- Chapter 1, Introduction, gives a brief introduction to the role of cryptography in data security. It describes the cryptographic algorithms that ICSF supports and discusses the importance of key secrecy.
- Chapter 2, Understanding Cryptographic Keys, describes how ICSF protects keys and controls their use. It also describes the types of keys and how ICSF protects data and keys within a system and outside a system.
- Chapter 3, Managing Cryptographic Keys, describes how to manage keys with ICSF. It introduces how to generate or enter, maintain, and distribute keys using ICSF. It also describes how to use keys to distribute keys and PINs between systems.

The remaining chapters of this book describe how to use the ICSF panels to manage cryptographic keys and also to view system status. Each chapter gives background information about a major task and leads you through the panels, step-by-step, for the task.

- Chapter 4, “Using the Pass Phrase Initialization Utility” on page 47 discusses pass phrase initialization and gives step-by-step instructions on how to get your cryptographic system up and running quickly. The pass phrase initialization utility allows you to install the necessary master keys on both the Cryptographic Coprocessor Features and the PCI Cryptographic Coprocessors, and initialize the CKDS with a minimal effort.
- Chapter 5, “Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise” on page 57 describes how to enter, activate, and manage master keys when using the Cryptographic Coprocessor Feature on the IBM S/390 Parallel Enterprise Server - Generation 3, or higher and the IBM S/390 Multiprise 2000 (S/390 Multiprise).
- Chapter 6, “Managing Master Keys on the S/390 Enterprise Server with PCI Cryptographic Coprocessors” on page 89 describes how to enter, activate, and manage master keys on a S/390 server with both the Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessor.
- Chapter 7, Managing the Master Key and Operational Keys on the ES/9000-9021 (Bipolar) Processor, describes how to enter, activate, and change a DES master key on the ES/9000-9021 (bipolar) processor. This chapter also explains how to use the key entry hardware to enter operational keys directly into the cryptographic key data set.
- Chapter 8, Managing Cryptographic Keys by Using the Key Generator Utility Program, describes how to use the *key generator utility program* (KGUP). The program generates keys and stores them in the *cryptographic key data set* (CKDS).
- Chapter 9, Viewing System Status, describes how to display information about parts of ICSF that your installation can specify and change. It describes how to use the panels to display installation options, hardware status, PCI management status, installation exits, and installation-defined services.
- Chapter 10, Using the Utility Panels to Encode and Decode Data, describes how to use utility panels to encipher and decipher data with a key that is not enciphered.
- Chapter 11, Using the ICSF Utility Program CSFEUTIL, describes how to use the CSFEUTIL utility program to change master keys and refresh or reencipher the CKDS.
- Appendix A, Control Vector Table, contains a table of the control vector values that are associated with each key type.
- Appendix B, Supporting Algorithms and Calculations, shows algorithms that are used to calculate checksums, verification patterns, and other values.
- Appendix C, PR/SM Considerations during Key Entry, discusses additional considerations when running in PR/SM logical partition mode.

Where to Find More Information

The information in this book is supported by other books in the ICSF library and other system libraries. The ICSF library is shown in Figure 1 on page xii.

The following publications contain additional ICSF information:

- *OS/390 MVS System Codes*, GC28-1780

This book describes the 18F abend code ICSF issues.

- *OS/390 MVS System Management Facilities (SMF)*, GC28-1783

  This book describes SMF record type 82, where ICSF records events.
- *OS/390 MVS Initialization and Tuning Guide*, SC28-1751
- *OS/390 MVS Initialization and Tuning Reference*, SC28-1752
- *OS/390 MVS Programming: Callable Services for HLL*, GC28-1768
- *OS/390 MVS Programming: Authorized Assembler Services Guide*, GC28-1763
- *OS/390 MVS Programming: Extended Addressability Guide*, GC28-1769
- *OS/390 MVS Programming: Authorized Assembler Services Reference ALE-DYN*, GC28-1764
- *OS/390 MVS Programming: Authorized Assembler Services Reference ENF-IXG*, GC28-1765
- *OS/390 MVS Programming: Authorized Assembler Services Reference LLA-SDU*, GC28-1766
- *OS/390 MVS Programming: Authorized Assembler Services Reference SET-WTO*, GC28-1767
- *MVS Batch Local Shared Resources*, GC28-1469
- *MVS/DFP Managing VSAM Data Sets*, SC26-4568
- *MVS/ESA Data Administration: Macro Instruction Reference*, SC26-4506-02

Related Publications

- *IBM Common Cryptographic Architecture: Cryptographic Application Programming Interface Reference*, SC40-1675
- *MVS Planning: Security*, GC28-1439
- *S/390 Support Element Operations Guide*, GC38-3118
- *S/390 PR/SM Planning Guide*, GA22-7236
- *S/390 Hardware Management Console Operations*, GC38-0459-00
- *IBM ES/9000 and ES/3090 Processor Complex PR/SM Planning Guide*, GA22-7123
- *IBM ES/3090 Processor Complex Recovery Guide*, SC38-0070
- *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide*, GA22-7142-05
- *IBM Security Architecture: Securing the Open Client/Server Distributed Enterprise*, SC28-8135
- *VTAM Programming for LU 6.2*, SC31-6551
- *RSA's Frequently Asked Questions About Today's Cryptography*, available on the World Wide Web. See RSA's home page at http://www.rsa.com.
- *Applied Cryptography, Second Edition*

Information on Other IBM Cryptographic Products

- *IBM Transaction Security System: General Information Manual and Planning Guide*, GA34-2137
- *IBM Transaction Security System: Concepts and Programming Guide: Volume I, Access Controls and DES Cryptography*, GC31-3937
- *IBM Transaction Security System: Concepts and Programming Guide: Volume II, Public-Key Cryptography*, GC31-2889
- *IBM Distributed Key Management System, Installation and Customization Guide*, GG24-4406

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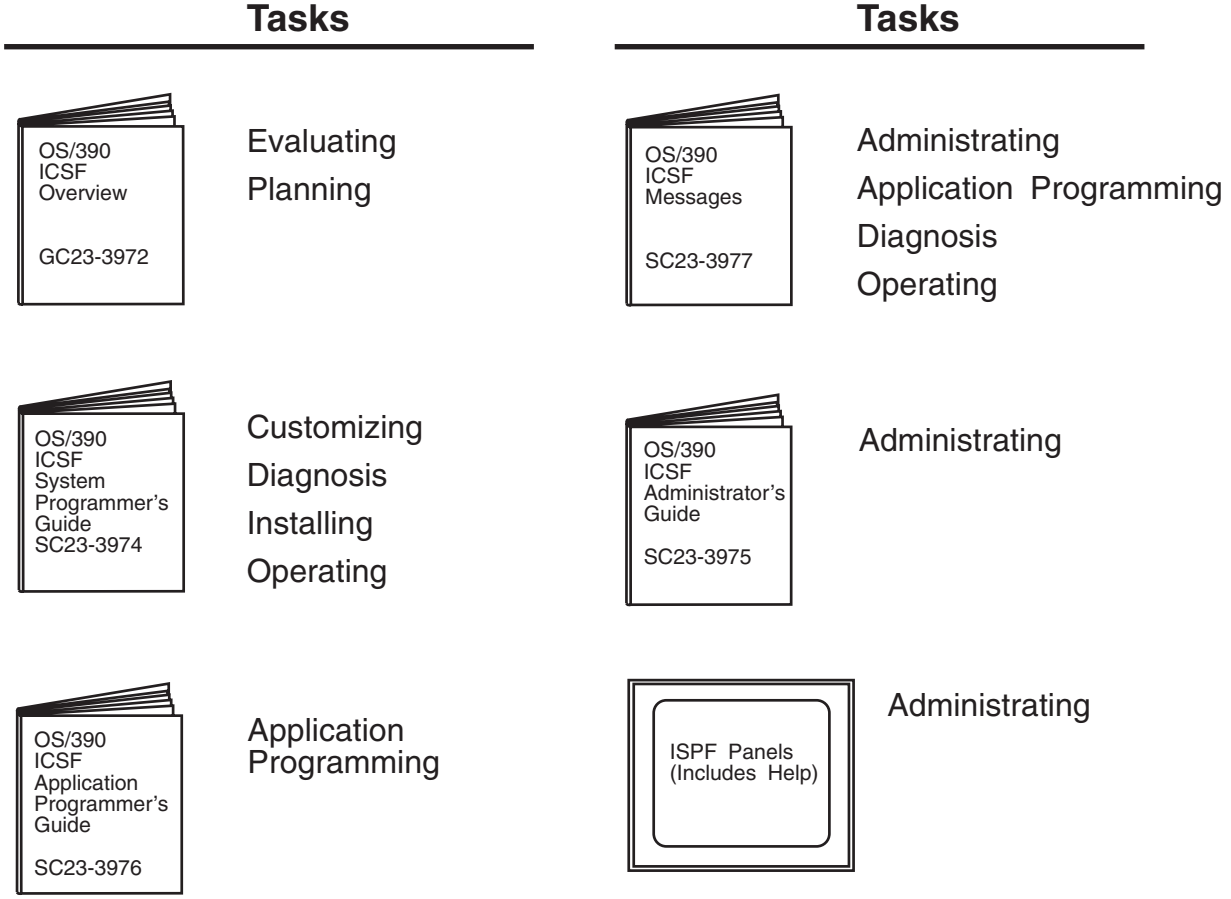

Figure 1. The ICSF/MVS Library

Summary of Changes

Summary of Changes
for SC23-3975-05
OS/390 Version 2 Release 9

New Information: This revision includes support for the PCI Cryptographic Coprocessor, an option available on the S/390 G5 Enterprise Server and the S/390 G6 Enterprise Server.

A new parameter, REASONCODES, has been added to the installation options data set.

The following new callable services support the PCI Cryptographic Coprocessor.

- Retained Key List (CSNDRKL)
- Retained Key Delete (CSNDRKD)
- PCI Interface (CSFPCI)

This book also includes changes to the master key entry panels and procedures to support the PCI Cryptographic Coprocessor. There is a new PCICC management panel.

This book includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Summary of Changes
for SC23-3975-04
OS/390 Version 2 Release 6 with APAR OW37791

This revision includes support for new key types (DATAM and DATAMV) for the compatibility double-length MAC keys, and withdrawal of support for double-length versions of MAC and MACVER keys.

This book includes terminology, maintenance, and editorial changes.

Summary of Changes
for SC23-3975-03
OS/390 Version 2 Release 6

This revision includes support for the following enhancements:

- Support for Secure Sockets Layer (SSL)
- Expanded Support for Double-key MAC

This book includes terminology, maintenance, and editorial changes.

Chapter 1. Introduction

In today's business environment, data is one of the most valuable resources that is required for maintaining a competitive edge. As a result, businesses must often be able to maintain data secrecy, readily determine the authenticity of data, and closely control access to data.

Data systems commonly consist of many types and sizes of computer systems that are interconnected through many different electronic data networks. It is now common for an organization to interconnect its data systems with systems that belong to customers, vendors, and competitors. Larger organizations might include international operations, or they might provide continual services. As the Internet becomes the basis for electronic commerce and as more businesses automate their data processing operations, the potential for disclosing sensitive data to unauthorized persons increases. As a result, approaches to data security must provide the following:

- Common services for each computing environment
- Support for national and international standards
- Graduated degrees of support
- Flexibility to work with existing and emerging systems
- Management of the increased risks to data assets

A combination of elements must work together to achieve a more secure environment. To provide a foundation for a secure environment, a security policy should be based on the following evaluations:

- An appraisal of the value of data
- An analysis of the potential threats to that data

The Tasks of a Data Security System

To help you select the products and services that you need to put a data security policy into effect, IBM has categorized the following security functions. These functions are based on the International Organization for Standardization (ISO) standard 7498-2:

- **Identification and authentication**—identifies users to the system and provides proof that they are who they claim to be.
- **Access control**—determines which users can access which resources.
- **Data confidentiality**—protects an organization's sensitive data from being disclosed to unauthorized individuals.
- **Data integrity**—ensures that data is in its original and unaltered form.
- **Security management**—administers, controls, and reviews a business security policy.
- **Nonrepudiation**—assures that a message sender cannot deny later that he or she sent the message.

The OS/390 Integrated Cryptographic Service Facility (ICSF) provides a cryptographic application programming interface that you can use along with your

system's cryptographic feature to put these functions into effect in your data security policy.

The Role of Cryptography in Data Security

Cryptography includes a set of techniques for scrambling or disguising data so that it is available only to someone who can restore the data to its original form. In current computer systems, cryptography provides a strong, economical basis for keeping data secret and for verifying data integrity.

ICSF supports the following two main types of cryptographic processes:

- Symmetric algorithms, in which the same key value is used in both the encryption and decryption calculations
- Asymmetric algorithms, in which a different key is used in the decryption calculation than was used in the encryption calculation

Symmetric Cryptography

ICSF supports two symmetric cryptography algorithms: The Data Encryption Algorithm, and the Commercial Data Masking Facility.

The Data Encryption Algorithm and the Data Encryption Standard

For commercial business applications, the cryptographic process that is known as the Data Encryption Algorithm (DEA)[1] has been widely adopted. The Data Encryption Standard (DES), as well as other documents, defines how to use the DES algorithm to encipher data. The Data Encryption Standard is the basis for many other processes for concealing data, such as protection of passwords and personal identification numbers (PINs). DES uses a key to vary the way that the algorithm processes the data. DES data-encrypting keys can be single-, double-, or triple-length. A single-length DES key is a 56-bit piece of data that is normally retained in 8 bytes of data. Each eighth bit of the key data is designated as a parity bit. A symmetric cryptographic system uses the same key both to transform the original data (plaintext) to its disguised, enciphered form (ciphertext) and to return it to its plaintext form.

The DES algorithm, which has been proven to be efficient and strong, is widely known. For this reason, data security is dependent on maintaining the secrecy of the cryptographic keys. Because the DES algorithm is common knowledge, you must keep the key secret to ensure that the data remains secret. Otherwise, someone who has the key that you used to encipher the data would be able to decipher the data. Key management refers to the procedures that are used to keep keys secret.

When you want someone to be able to confirm the integrity of your data, you can use the DES algorithm to compute a message authentication code (MAC). When used in this way, the DES algorithm is a powerful tool. It is almost impossible to meaningfully change the data and still have it produce the same MAC for a given

[1] The Data Encryption Algorithm is often referred to as the DEA, the DES algorithm or just as DES. This document uses the term DES to refer to this algorithm.

key. The standardized approaches authenticate data such as financial transactions, passwords, and computer programs.

The originator of the data sends the computed MAC with the data. To authenticate the data, the receiver uses the DES algorithm to recompute the MAC. The receiver's application then compares this result with the MAC that was sent with the data. Someone could, of course, change both the data and the MAC. Therefore, the key that is used to compute the MAC must be kept a secret between the MAC's originator and the MAC's authenticator.

An alternative approach to data-integrity checking uses a standard key value and multiple iterations of the DES algorithm to generate a modification detection code (MDC). In this approach to data-integrity checking, the MDC must be received from a trusted source. The person who wants to authenticate the data recomputes the MDC and compares the result with the MDC that was sent with the data.

The Commercial Data Masking Facility

The Commercial Data Masking Facility (CDMF) defines a scrambling technique for data confidentiality. CDMF is a substitute for DES for those customers who have been previously prohibited from receiving IBM products that support DES data confidentiality services.

The CDMF data confidentiality algorithm is a cryptographic system that provides data masking and unmasking. The algorithm includes both a key-shortening process and a standard DES encryption and decryption process. The first process shortens the key to an effective length of 40 bits prior to its use in the data masking process. CDMF uses the DES algortihm with the shortened key to ensure confidence in the CDMF algorithm.

Asymmetric Algorithm or Public Key Cryptography

In an asymmetric cryptographic process one key is used to encipher the data, and a different but corresponding key is used to decipher the data. A system that uses this type of process is known as a public key system. The key that is used to encipher the data is widely known, but the corresponding key for deciphering the data is a secret. For example, many people can use your public key to send enciphered data to you with confidence, knowing that only you should possess the secret key for deciphering the data.

Public key cryptographic algorithms are used in processes that simplify the distribution of secret keys, assuring data integrity and provide nonrepudiation through the use of digital signatures.

The widely known and tested public key algorithms use a relatively large key. The resulting computer processing time makes them less than ideal for data encryption that requires a high transaction rate. Public key systems, therefore, are often restricted to situations in which the characteristics of the public key algorithms have special value, such as digital signatures or key distribution. On the IBM S/390 Parallel Enterprise Server - Generation 3 (S/390 G3 Enterprise Server), or above and the IBM S/390 Multiprise 2000, PKA calculation rates are fast enough to enable the common use of digital signatures.

ICSF supports the following public key algorithms:

- Rivest-Shamir-Adelman (RSA)

- Digital Signature Standard (DSS)

The RSA Public Key Algorithm

The Rivest-Shamir-Adelman (RSA)[2] public key algorithm is based on the difficulty of the factorization problem. The factorization problem is to find all prime numbers of a given number, n. When n is sufficiently large and is the product of a few large prime numbers, this problem is believed to be difficult to solve. For RSA, n is typically at least 512 bits, and n is the product of two large prime numbers. The ISO 9796 standard and *RSA's Frequently Asked Questions About Today's Cryptography* provide more information about the RSA public key algorithm.

The DSS Public Key Algorithm

The U.S. National Institute of Science and Technology (NIST) Digital Signature Standard (DSS) public key algorithm is based on the difficulty of the discrete logarithm problem. The discrete logarithm problem is to find x given a large prime p, a generator g and a value y = (g**x) mod p. In this equation, ** represents exponentiation. This problem is believed to be very hard when p is sufficiently large and x is a sufficiently large random number. For DSS, p is at least 512 bits, and x is 160 bits. DSS is defined in the NIST Federal Information Processing Standard (FIPS) 186 Digital Signature Standard.

A DSS key pair includes a private and a public key. The DSS private key is used to generate a digital signature, and the DSS public key is used to verify a digital signature.

The Cryptographic Facilities Supported by OS/390 ICSF

The cryptographic hardware, or *cryptographic feature*, available to your applications depends on your processor or server model. OS/390 ICSF supports the following cryptographic features.

- Cryptographic Coprocessor Feature

  The Cryptographic Coprocessor Feature is available as a feature on the S/390 Enterprise Servers and S/390 Multiprise. These complementary metal oxide semiconductor (CMOS) servers are referred to by their shortened names throughout this manual. The Cryptographic Coprocessor Feature supports all the cryptographic algorithms and callable services available with OS/390 ICSF.

- PCI Cryptographic Coprocessor

  The PCI Cryptographic Coprocessor is a SecureWay 4758 model 2 standard PCI-bus card available as a field upgrade on the S/390 G5 Enterprise Server and on the S/390 G6 Enterprise Server. The PCI Cryptographic Coprocessor supports all the cryptographic algorithms and callable services available with OS/390 ICSF.

- Integrated Cryptographic Feature (ICRF)

  The Integrated Cryptographic Feature (ICRF) is available as a separate option on the ES/9000-9021 (bipolar) processors. OS/390 ICSF continues to support the cryptographic algorithm available on the ICRF and the callable services available with ICSF/MVS Version 1 Release 2. The callable services and

[2] Invented in 1977 by Ron Rivest, Adi Shamir, and Leonard Adelman

cryptographic algorithms that became available with ICSF Version 2 Release 1 (and are a part of OS/390 ICSF) are not supported by the ICRF.

For a complete listing of the OS/390 ICSF callable services and the cryptographic features that support them, refer to the *OS/390 ICSF Application Programmer's Guide*.

Because the DES algorithm has been used for many years, its strength has been well demonstrated. The DES algorithm can be implemented in both software and specialized hardware. A hardware solution, such as the Cryptographic Coprocessor Feature or the ICRF, is often desirable because it provides the following advantages:

- More secure protection to maintain the secrecy of keys
- Greater transaction rates

If a data security threat comes from an external source, a software implementation of the cryptographic algorithm might be sufficient. Unfortunately, however, much fraud originates with individuals within the organization (insiders). As a result, specialized cryptographic hardware can be required to protect against both insider and outsider data security threats. Well-designed hardware can do the following:

- Ensure the security of cryptographic keys
- Ensure the integrity of the cryptographic processes
- Limit the key-management activities to a well-defined and carefully controllable set of services

The Role of Key Secrecy in Data Security

In both the symmetric key and asymmetric key algorithms, no practical means exists to identically cipher data without knowing the cryptographic key. Therefore, it is essential to keep a key secret at a cryptographic node. In real systems, however, this often does not provide sufficient protection. If adversaries have access to the cryptographic process and to certain protected keys, they could possibly misuse the keys and eventually compromise your system. A carefully devised set of processes must be in place to protect and distribute cryptographic keys in a secure manner.

ICSF, and other products that comply with the IBM Common Cryptographic Architecture (CCA), provide a means of controlling the use of cryptographic keys. This protects against the misuse of the cryptographic system.

This manual explains the concepts of key management and gives step-by-step instructions for using ICSF to generate, enter, and manage cryptographic keys. Separate chapters describe key management on the Cryptographic Coprocessor Feature and the Integrated Cryptographic Feature.

Chapter 2. Understanding Cryptographic Keys

To understand cryptographic keys, you need to know the types of keys that exist and how ICSF protects them and controls their use. The Integrated Cryptographic Service Facility uses a hierarchical key management approach. A master key protects all the keys that are active on your system. Other types of keys protect keys that are transported out of the system. This chapter gives you an understanding of how ICSF organizes and protects keys.

Values of Keys

Keys can either be clear or encrypted. A clear key is the base value of a key. A clear key is not encrypted under another key. To create an encrypted key, either a master key or a transport key is used to encrypt the base value of the key.

Clear keys endanger security. In symmetric cryptographic processes, such as DES, anyone can use the clear key and the publicly known algorithm to decipher data, key values, or PINs. In asymmetric cryptographic processes it is important to protect the clear value of the private key. It would cause a serious security exposure if the wrong person obtained the value of the private key. It could be used to forge electronic signatures on documents, or decipher key values encrypted under the corresponding public key.

ICSF uses clear key values to *encode* and *decode* data. You can use the encode and decode callable services or the ICSF utility panels to encode and decode data. For a description of the callable services, see the *OS/390 ICSF Application Programmer's Guide*. For a description of how to use the utility panels, see Chapter 10, Using the Utility Panels to Encode and Decode Data.

ICSF may have to input and output clear keys. For example, it might receive and send clear keys when it communicates with other cryptographic systems that use clear keys in their functions. When you give ICSF a clear key value, ICSF can encrypt the key before using it on the system. ICSF has specific callable services that perform this function. These callable services are clear key import and secure key import, which are described in the *OS/390 ICSF Application Programmer's Guide*.

You can use the ICSF panels to enter and output clear keys. See “Entering Keys into the Cryptographic Key Data Set (CKDS)” on page 27 and “Distributing Cryptographic Keys” on page 33 for a description of how to do this. For a description of entering a clear master key, see “Entering Clear Master Key Parts” on page 57.

Types of Keys

ICSF groups the cryptographic keys into the following categories, which correspond to the functions they perform:

- DES master keys
- Symmetric-keys master key on the PCI Cryptographic Coprocessor
- PKA master keys
- Asymmetric-keys master key on the PCI Cryptographic Coprocessor

- Data-encrypting keys
- Data-translation keys
- MAC keys
- PIN keys
- Transport keys
- PKA keys

Master Keys

ICSF uses master keys to protect other keys. Keys are active on a system only when they are encrypted under a master key variant, so the master key protects all keys that are used on the system. A key is in operational form when it has been encrypted under a master key variant.

The ICSF administrator initializes and changes master keys using the ICSF panels and, if needed, the ICRF hardware (on bipolar processors). Master keys always remain in a secure area in the cryptographic hardware.

ICSF uses three types of master keys to protect keys that are used with the S/390 cryptographic feature:

DES Master Key
The DES master key is a double-length (128-bit) key that is used to protect DES and CDMF keys. Both the Cryptographic Coprocessor Feature and the ICRF require a DES master key.

PKA Key Management Master Key
The PKA key management master key (KMMK) is a triple-length (192-bit) key. The KMMK protects PKA private keys that are used in both the digital signature services and in the CDMF and DES data key distribution functions. Support for the PKA KMMK is available only on the Cryptographic Coprocessor Feature on the S/390 G3 Enterprise Server, or higher and the S/390 Multiprise.

PKA Signature Master Key
The PKA signature master key (SMK) is a triple-length (192-bit) key. The SMK protects PKA private keys that are used only in digital signature services. Support for the PKA SMK is available only on the Cryptographic Coprocessor Feature on the S/390 G3 Enterprise Server, or higher and the S/390 Multiprise.

ICSF uses two types of master keys to protect keys that are used with the PCI Cryptographic Coprocessor:

Symmetric-keys Master Key
The symmetric-keys (SYM-MK) master key is a double-length (128-bit) key that is used to protect DES keys used on the PCI Cryptographic Coprocessor. SYM-MK is actually a triple length (192-bit) Master Key that ICSF enforces to be equivalent to a double length (128-bit) master Key. This key must have the same value as the DES master key on the S/390 cryptographic feature.

Asymmetric-keys Master Key
The asymmetric-keys (ASYM-MK) master key is a triple-length (192-bit) key. The ASYM master key protects PKA private keys that are used on the PCI Cryptographic Coprocessor. This key must have the same value as the SMK on the S/390 cryptographic feature.

Data-Encrypting Keys

Data-encrypting keys, also referred to as data keys, can be single-length, double-length, or triple-length.

Single-length (64-bit) keys are used with the DES algorithm and the CDMF in data confidentiality services. When used with the DES algorithm, the effective key length is 56 bits; the other 8 bits contain parity information. The CDMF algorithm prior to the data confidentiality calculation shortens the data-encrypting keys to an effective length of 40 bits.

Double-length and triple-length DATA keys can be used only with the DES algorithm.

In the operational form, a data key can be used to encipher and decipher data. In the clear form, a data key can be used to encode and decode data on a DES system only. Single-length data-encryption keys can also be used in place of the MAC keys to generate or verify a message authentication code.

Data-Translation Keys

Data-translation keys are single-length (64-bit) keys that protect data that is transmitted through intermediate systems when the originator and receiver do not share a common key. Data that is enciphered under one data-translation key is reenciphered under another data-translation key on the intermediate node. During this process, the data never appears in the clear.

A data-translation key cannot be used in the decipher callable service to decipher data directly. It can translate the data from encipherment under one data-translation key to encipherment under another data-translation key. See “Protection of Data” on page 20 for a description of how data-translation keys protect data that is sent through intermediate systems.

MAC Keys

Message authentication is the process of verifying the integrity of transmitted messages. Message authentication code (MAC) processing enables you to verify that a message has not been altered. You can use a MAC to check that a message you receive is the same one the message originator sent. The message itself may be in clear or encrypted form. MAC keys are either single-length (64-bit) or double-length (128-bit) keys.

Note: In order to generate and use double-length MAC keys in importable or exportable form, the CKDS must contain NOCV-enablement keys and ANSI system keys. You will need to refresh any existing CKDS and add these keys during the process. For information on refreshing a CKDS refer to “Refreshing the CKDS at Any Time” on page 76. When creating a new CKDS, add the NOCV-enablement keys and ANSI system keys during the initialization process. For information on initializing a CKDS, refer to “Initializing the CKDS at First-Time Startup” on page 74.

ICSF uses the following MAC keys in message authentication:

MAC Generation Keys

Before sending a message, an application program can generate an authentication code for the message, using the MAC generate callable service. The callable service computes the message authentication code by using a

MAC generation key to process the message text. The originator of the message sends the message authentication code with the message text.

Single-length MAC generation keys (MAC keys) are used in the ANSI X9.9-1 MAC procedure. They support EMV algorithms. Double-length MAC generation keys (DATAM keys) are used in the ANSI X9.19 optional double key MAC procedure. For compatibility with ICSF Version 2 Release 1, ICSF continues to support the MACD key type, which uses the single-length control vector for both the left and right half of the key to create an external token (MAC || MAC).

MAC Verification Key
The message receiver uses a single-length (MACVER) or double-length (DATAMV) MAC verification key to verify the message authentication code that the message originator sends.

Note: Double-length DATAMV keys are supported only on the S/390 G5 Enterprise Server, or above.

When the receiver gets the message, an application program calls the MAC verify callable service. The callable service verifies a message authentication code by using the MAC verification key to process the message text. It compares the MAC it generates internally with the MAC that was sent with the message. If the two MACs are the same, the message that was sent is identical to the message that was received.

The MAC generation key the sender uses and the MAC verification key the receiver uses have the same clear value. However, each is protected under the master key variant for its key type.

PIN Keys

Personal authentication is the process of validating personal identities in a financial transaction system. The personal identification number (PIN) is the basis for verifying the identity of a customer across the financial industry networks. A PIN is a number that the bank customer enters into an automatic teller machine (ATM) to identify and validate a request for an ATM service.

You can use ICSF to generate PINs and PIN offsets. A PIN offset is a value that is the difference between two PINs. For example, a PIN offset may be the difference between a PIN that is chosen by the customer and one that is assigned by an institution. You can use ICSF to verify the PIN that was generated by ICSF. You can also use ICSF to protect PIN blocks that are sent between systems and to translate PIN blocks from one format to another. A PIN block contains a PIN and non-PIN data. You use PIN keys to generate and verify PINs and PIN offsets, and to protect and translate PIN blocks. All PIN keys are double-length (128-bit) keys.

PIN Keys for Generating and Verifying PINs and PIN Offsets

The following PIN keys generate and verify PINs and PIN offsets:

PIN Generation Key
A PIN generation key is used in an algorithm to generate PINs or PIN offsets.

To generate PINs, use an application program to call the PIN generate callable service. The PIN generation algorithm uses the PIN generation key and some relevant data to generate a clear PIN, a PIN verification value, or an offset.

PIN Verification Key

A PIN verification key is used in an algorithm to verify PINs and PIN offsets.

To verify a supplied PIN, use an application program to call the PIN verification callable service. You need to specify the supplied enciphered PIN block and PIN-encrypting key that enciphers it. You must also specify the PIN verification key, the PIN verification algorithm, and other relevant data. The callable service generates a verification PIN. It compares the supplied PIN and the verification PIN, and if they are the same, it verifies the supplied PIN.

For a specific PIN generation key and PIN verification key pair, the PIN generation key and the PIN verification key have the same clear value. However, each key is protected by the master key variant for its key type.

PIN Keys to Protect and Translate PIN Blocks

The following PIN keys protect and translate PIN blocks:

Output PIN-Encrypting Key

Two systems must share a common key for securely transmitting PIN blocks. The output PIN-encrypting key protects PIN blocks that are sent from your system to another system.

PIN-encrypting keys are used in the PIN translate service. Use the PIN translate service to translate PIN blocks from protection under one PIN-encrypting key to protection under another PIN-encrypting key. You can also use the PIN translate service to translate a PIN block from one PIN block format to another PIN block format. For more information about the PIN translate service, see the *OS/390 ICSF Application Programmer's Guide*.

Input PIN-Encrypting Key

Two systems must share a common key for securely transmitting PIN blocks. The input PIN-encrypting key protects PIN blocks that are sent from another system to your system.

PIN-encrypting keys are used in the PIN translate service. You also use the input PIN-encrypting key in the PIN verify service. For more information about the PIN translate service and PIN verify service, see the *OS/390 ICSF Application Programmer's Guide*.

For a specific pair of PIN-encrypting keys, the input PIN-encrypting key and the output PIN-encrypting key have the same clear value. However, each key is protected by the master key variant for its key type.

Transport Keys

Transport keys protect a key that is sent to another system, received from another system, or stored with data in a file. Transport keys are double-length (128-bit) keys.

The following transport keys support the Common Cryptographic Architecture:

Exporter Key-encrypting Key

An exporter key-encrypting key protects keys that are sent from your system to another system. The exporter key at the originator has the same clear value as the importer key at the receiver. Exporter key-encrypting keys are double-length keys.

Importer Key-encrypting Key
An importer key-encrypting key protects keys that are sent from another system to your system. It also protects keys that you store externally in a file that you can import to your system later. The importer key at the receiver has the same clear value as the exporter key at the originator. Importer key-encrypting keys are double-length keys.

For a specific pair of transport keys, the importer key-encrypting key and the exporter key-encrypting key have the same clear value. However, each key is protected by the master key variant for its key type.

ICSF provides the following transport key type to support the ANSI X9.17 standard.

ANSI Key-encrypting Key
An importer and exporter key-encrypting key that is used in the ANSI key management callable services. ANSI key-encrypting keys (AKEKs) are bidirectional and are either single- or double-length keys.

PKA Keys

ICSF supports the use of public key cryptography on the S/390 G3 Enterprise Server, or higher and the S/390 Multiprise. This requires the generation of a pair of PKA keys. One key is made public, and the other key is kept private. The private key is protected through encryption under the appropriate PKA master key. The public key is used to encrypt DES data-encrypting keys in a key distribution system. The private key is then used to decrypt the DES data-encrypting key. The private key is also used for generating digital signatures which are verified using the corresponding public key.

ICSF supports the use of the following PKA keys.

RSA
An RSA key pair includes a private key and a public key. RSA keys can be used for key distribution and authentication. When used for key distribution, a DES key is encrypted under an RSA public key by the sender. The key can only be decrypted with the receiver's private key. When used for authentication, the RSA private key is used for digital signature generation and the RSA public key is used for digital signature verification.

The optional PCI Cryptographic Coprocessor provides the ability to generate RSA public and private key pairs within its secure hardware boundary. In OS/390 V2 R9 ICSF, the PKA key generate callable service has been enhanced to provide support for the generation of RSA keys on the PCI card.

The Cryptographic Coprocessor Feature (CCF) does not provide the ability to generate RSA public and private keys within its secure hardware boundary. If you have CCF, you can generate RSA key pairs in the encrypted form on a TKE Workstation with APAR OW32982 or a workstation with a 4755 or 4758 cryptographic adapter installed. RSA keys generated on the TKE workstation can be loaded directly to the PKDS from the TKE workstation. RSA keys generated on a non-TKE workstation can use the PKA key import callable service to import the RSA key pair to the Cryptographic Coprocessor Feature.

DSS
A DSS key pair also includes a private and a public key. The DSS private key is used for digital signature generation, and the DSS public key is used for digital signature verification.

ICSF provides a callable service to generate PKA internal key tokens for use with the DSS algorithm in digital signature services.

RSA and DSS public and private keys can be stored in the PKA key data set (PKDS), a VSAM data set. Alternatively, an RSA private key may be retained in the PCI Cryptographic Coprocessor where it was generated. For retained private keys, only the public key is stored in the PKDS. For more information about the PKDS, refer to “Setting Up and Maintaining the PKDS” on page 33.

Protection and Control of Cryptographic Keys

Because the cryptographic algorithms are all key-controlled algorithms, the security of protected data depends on the security of the cryptographic key. With the exception of master keys, which are physically secured, all keys are enciphered under another key to provide this necessary security.

A key is protected under either a master key, a transport key, or a PKA key. The master key protects a key you use on the system. When you send a key to another system, you protect it under a transport key rather than under the master key. You can also use RSA public keys to protect DES data-encrypting keys that are transported between systems.

ICSF controls the use of keys by separating them into types that can be used to do only specific functions.

Master Key Concept

ICSF uses the master key concept to protect cryptographic keys. Master keys, which are stored in secure hardware in the cryptographic feature, are used to encrypt all other keys on the system. All other keys that are encrypted under these master keys are stored outside the protected area of the cryptographic feature. This is an effective way to protect a large number of keys while needing to provide physical security for only a few master keys.

The master keys are used only to encipher and decipher keys. Other key-encrypting keys that are called *transport keys* also encipher and decipher keys and are used to protect cryptographic keys you transmit to other systems. These transport keys, while on the system, are also encrypted under a master key.

Key Separation

The cryptographic hardware, or cryptographic feature, controls the use of keys by separating them into unique types. How a key is used distinguishes it from other keys. The cryptographic feature allows you to use only a specific type of key for its intended purpose. For example, a key that is used to protect data cannot be used to protect a key. Depending on the processor model, you may have one or two of the following cryptographic features:

- Cryptographic Coprocessor Feature

  This feature is available on the S/390 G3 Enterprise Server, or higher, and the S/390 Multiprise.

- PCI Cryptographic Coprocessor

  This option is available on the S/390 G5 and G6 Enterprise Server with field upgrades and works along with the S/390 Cryptographic Coprocessor Feature.

- Integrated Cryptographic Feature (ICRF)

  This feature is available on ES/9000-9021 (bipolar) processors.

Depending on the cryptographic feature, an ICSF system may have up to five master keys.

- A DES master key, which protects keys that are used in DES or CDMF operations on the S/390 cryptographic feature.

  In this manual, the term “DES master key” refers to the master key that is used to protect keys that you use in DES or CDMF services. All S/390 cryptographic features require a DES master key.
- A symmetric-keys (SYM-MK) master key, which protects keys that are used in DES operations on the PCI Cryptographic Coprocessor
- A PKA key management master key (KMMK), which protects keys that are used in PKA key distribution operations on the Cryptographic Coprocessor Feature.
- A PKA signature master key (SMK), which protects keys that are used in digital signature operations on the Cryptographic Coprocessor Feature.
- An asymmetric-keys (ASYM-MK) master key, which protects RSA keys used in key distribution and authentication operations on the PCI Cryptographic Coprocessor.

DES Master Key Variants Protect DES and CDMF Keys

To provide for key separation, the cryptographic feature automatically encrypts each type of key that is used in either DES or CDMF services under a unique variation of the DES master key. Each variation encrypts a different type of key. Although you define only one master key, in effect you have a unique master key to encrypt each type of key that is used in DES or CDMF services.

A key that is protected under the master key is in *operational form*, which means that ICSF can use it in cryptographic functions on the system. As is shown in Figure 2 on page 15, all keys that you want ICSF to use in cryptographic functions are enciphered under the master key.

Whenever the master key is used to encipher a key, the cryptographic feature produces a variation of the master key according to the type of key that is being enciphered. These variations are called *master key variants*. The cryptographic feature creates a master key variant by exclusive ORing a fixed pattern, called a *control vector*, with the master key. Each type of key that is used in DES or CDMF services has a unique control vector associated with it. For example, the cryptographic feature uses one control vector when the master key enciphers a PIN generation key, and a different control vector when the master key enciphers a PIN verification key.

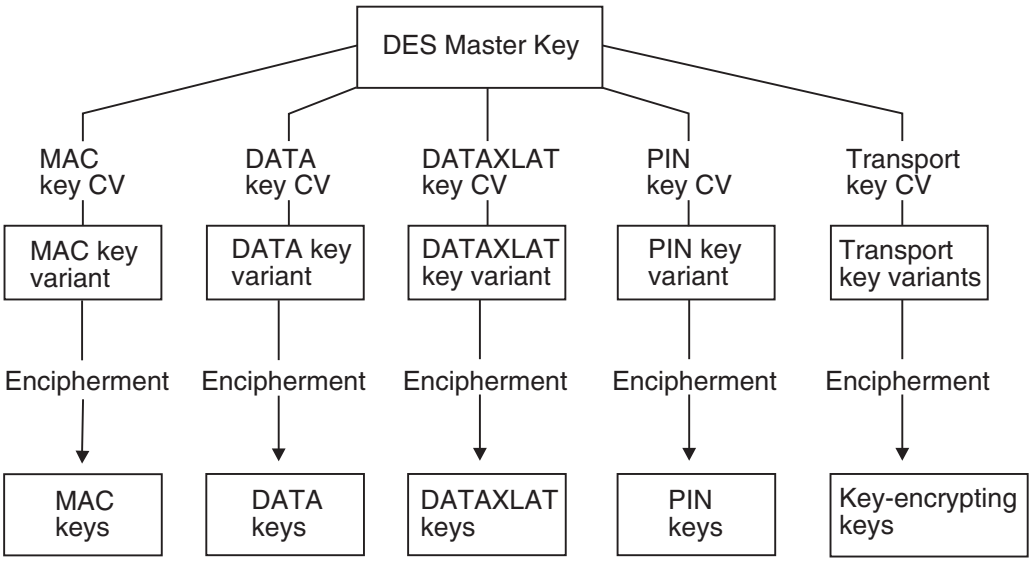

Figure 2. Keys Protected in a System

When systems want to share keys, transport keys can be used to protect keys sent outside of systems. A key that is enciphered under a transport key cannot be used in a cryptographic function. The key must first be brought into a system, deciphered from under the transport key, and enciphered under the system's master key.

ICSF creates variations of a transport key to encrypt a key according to its type. Whenever a transport key is used to encipher a key, the cryptographic feature produces the variation of the transport key according to the type of key that is being enciphered. This allows for key separation when a key is transported off the system.

A transport key variant, also called a *key-encrypting key variant*, is created in the same way as a master key variant. The transport key is exclusive ORed with a control vector that is associated with the key type of the key it protects. See Appendix A, Control Vector Table for a listing of the control vector that is used for each key type.

DES cryptographic keys can be single- or double-length keys, depending on their key type. A single-length key is 64 bits, and a double-length key is 128 bits. For double-length keys, one control vector exists for the left half of the key and another control vector for the right half. Therefore, ICSF creates a master key variant or transport key variant for each half of the key the master key or transport key will protect.

Multiple Encipherment

The cryptographic feature uses multiple encipherment when it enciphers a key under a key-encrypting key such as the master key or a transport key. Multiple encipherment is used whenever the key-encrypting key is double-length. The cryptographic feature enciphers each half of the key that it is encrypting.

To multiple-encipher the left half of a key, the cryptographic feature performs the following steps:

1. Exclusive ORs the left half of the key-encrypting key with the control vector for the left half of the key to create the variant. The cryptographic feature then enciphers the left half of the key under this variant.
2. Exclusive ORs the right half of the key-encrypting key with the control vector for the left half of the key to create the variant. The cryptographic feature then deciphers the value that results from step 1 under this variant.
3. Exclusive ORs the left half of the key-encrypting key with the control vector for the left half of the key. The cryptographic feature then enciphers the value that results from step 2 under this variant.

To multiple-encipher the right half of the key, the cryptographic feature performs the following steps:

1. Exclusive ORs the left half of the key-encrypting key with the control vector for the right half of the key to create the variant. The cryptographic feature then enciphers the right half of the key under this variant.
2. Exclusive ORs the right half of the key-encrypting key with the control vector for the right half of the key to create the variant. The cryptographic feature then deciphers the value that results from step 1 under this variant.
3. Exclusive ORs the left half of the key-encrypting key with the control vector for the right half of the key. The cryptographic feature then enciphers the value that results from step 2 under this variant.

On ICSF, an effective single-length key can exist as a double-length key; each key half has an identical value. The result of the multiple encipherment process on an effective single-length key is the key value that is encrypted once under the variant.

Migrating from CUSP or PCF Key Types

Your installation may use the IBM cryptographic products, Cryptographic Unit Support Program (CUSP), or Programmed Cryptographic Facility (PCF). ICSF provides key types that are similar to the CUSP and PCF key types. Also, ICSF provides other key types for enhanced key separation and more functions. You cannot use a CUSP or PCF key on ICSF, but you can convert a CUSP or PCF key into an ICSF key. Figure 3 lists which ICSF key types correspond to the CUSP and PCF key types.

Figure 3. CUSP/PCF and Corresponding ICSF Key Types

CUSP/PCF Key Type	**ICSF Key Type**
Local key	Exporter key-encrypting key or Output PIN-encrypting key
Remote key	Importer key-encrypting key or Input PIN-encrypting key
Cross key	Importer key-encrypting key and exporter key-encrypting key or Input PIN-encrypting key and output PIN-encrypting key

ICSF provides compatibility modes and a conversion program to help you run CUSP or PCF with ICSF and to migrate from CUSP or PCF to ICSF. The conversion program converts CUSP or PCF keys to ICSF keys. For information about using the compatibility modes and the conversion program, see the *OS/390 ICSF System Programmer's Guide*.

Protection of Distributed Keys

When you store a key with a file or send it to another system, you can protect the key in either of the following ways:

- Encipher it under a DES transport key.
- Encipher it under the receiver's RSA public key.

When ICSF enciphers a key under a DES transport key, the key is not in operational form and cannot be used to perform cryptographic functions. When you receive a key from a system, the key is enciphered under a transport key. You can reencipher the key from under the transport key to under your master key. You can then use the key on your system. When a key is enciphered under a transport key, the sending system considers it in exportable form, and the receiving system considers it in importable form. When a key is reenciphered from under a transport key to under a system's master key, it is in operational form again.

In an RSA public key cryptographic system, the sending system and receiving system do not need to share complementary importer and exporter key pairs to exchange data-encrypting keys. The sender uses the receiver's public key to encipher the data-encrypting key. The receiver uses his or her own private key to decipher the data-encrypting key. You can use RACF to control which applications can use specific keys and services. For more information, see “Controlling Who Can Use Cryptographic Keys and Services” on page 40.

Protecting Keys Stored with a File

You may want to store encrypted data in a file that is stored on DASD or on magnetic tape. For example, if you use a data-encrypting key to encrypt data in a file, you can store the data-encrypting key with the encrypted data. As is shown in Figure 4 on page 18, you use an importer key-encrypting key to encrypt the data-encrypting key.

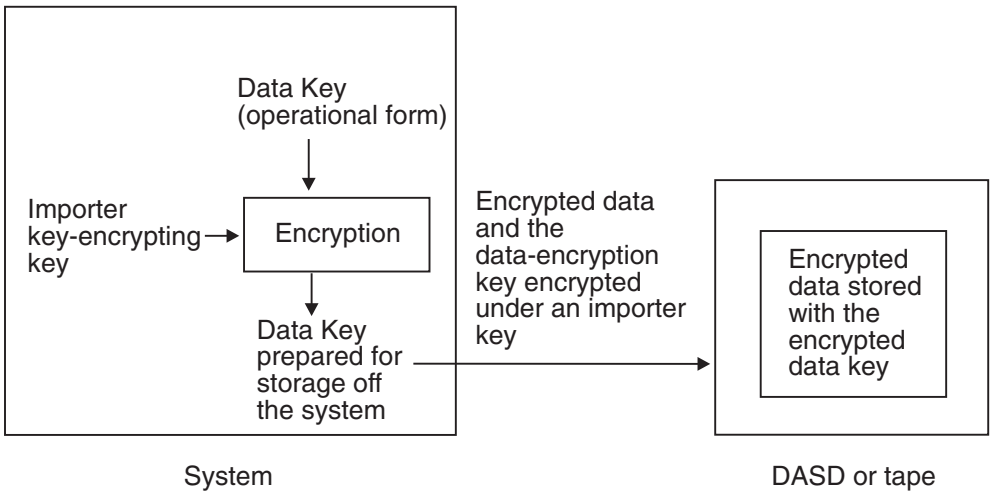

Figure 4. Keys Protected in a File Outside the System

When you encipher a key under an importer key, the key is no longer enciphered under the master key and is no longer operational. You can store the key off the system because the key will not become obsolete if you change the master key. The importer key that protects the data-encrypting key is reenciphered under the correct master key during a master key change. Therefore, when enciphered under the importer key, the data-encrypting key is not directly affected by a master key change.

When you are ready to use the data-encrypting key, use ICSF to reencipher it from under the transport key to under the master key. This makes the data-encrypting key operational. You can then use the data-encrypting key to decrypt the data.

Using DES Transport Keys to Protect Keys Sent between Systems

You can send and receive keys and PINs between your system and another system. For example, if you send encrypted data to another system, you also send the data-encrypting key that enciphered the data. The other system can then use the data-encrypting key to decipher the data. In a financial system, you might need to send a PIN from the system that received the PIN from a customer to a system that uses it to verify a customer's identity. As shown in Figure 5 on page 19, when you send the PIN between systems, you encipher the PIN under a PIN-encrypting key.

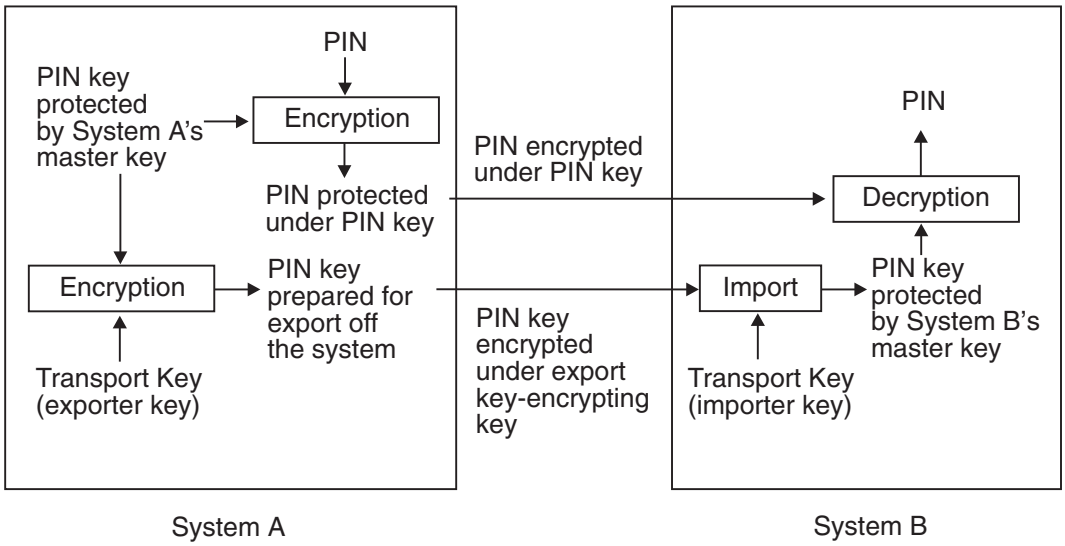

Figure 5. Keys and PINs Protected When Sent between Two Systems

Two systems do not share a master key. When you send a key to another system, you do not encrypt it under a master key. You encrypt it under a transport key.

Two systems that exchange keys share transport keys that have the same clear value. At the sending system, the transport key is an exporter key-encrypting key. At the receiving system, the transport key is an importer key-encrypting key. When the sending system wants to send a key, the sending system encrypts the key under an exporter key-encrypting key. The key is in exportable form on the system that sends the key.

The key is in importable form on the system that receives the key. The receiving system reencrypts the key from under the importer key-encrypting key to under its own master key. The key is then in operational form and can be used on the system.

Using RSA Public Keys to Protect Keys Sent between Systems

The ability to create more-secure key-exchange systems is one of the advantages of combining both DES and PKA support in the same cryptographic system. Because PKA cryptography is more computationally intensive than DES cryptography, it is not the method of choice for all cryptographic functions. It can be used, however, in combination with DES cryptography to enhance the security of key exchange. DES data-encrypting keys can be exchanged safely between two systems when encrypted using an RSA public key. Sending system and receiving system do not need to share a secret key to be able to exchange RSA-encrypted DES data-encrypting keys. An example of this is shown in Figure 6. The sending system enciphers the DES data-encrypting key under the receiver's RSA public key and sends the enciphered data-encrypting key to the receiver. The receiver uses his or he RSA private key to decipher the data-encrypting key.

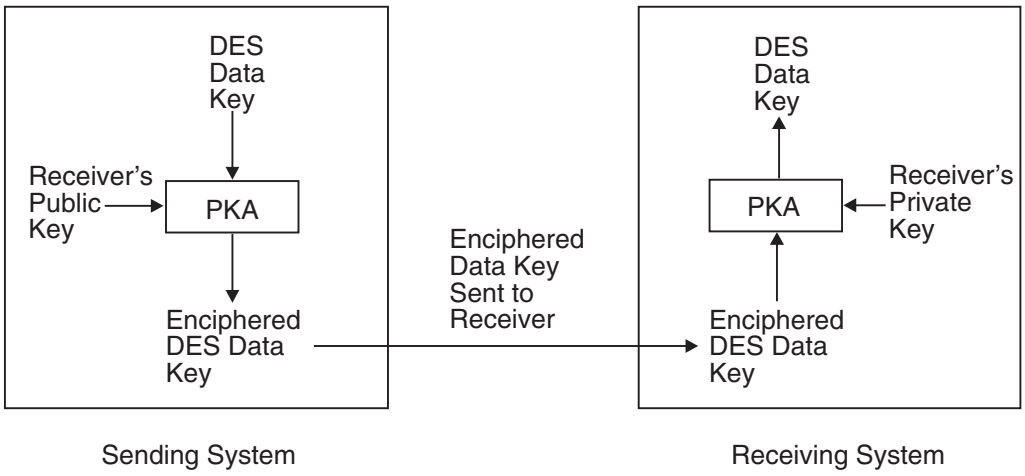

Figure 6. Distributing a DES Data-Encrypting Key Using an RSA Cryptographic Scheme

Note: Only DES and CDMF data-encrypting keys can be encrypted under RSA public keys.

Protection of Data

You use data-encrypting keys to encrypt data. On a system, a data-encrypting key is encrypted under the master key.

A data-encrypting key can encrypt data that is stored in a file outside the system. The data-encrypting key itself is encrypted under a transport key.

You may also need to protect data that you send from one system to another system. The data-encrypting key that protects this data must be sent with the data so that the receiving system can decrypt the data. In this case, the data-encrypting key is encrypted under a transport key.

Sometimes two systems that want to exchange data are not directly connected. There may be intermediate systems between the systems that the data must travel through, as in Figure 7 on page 21.

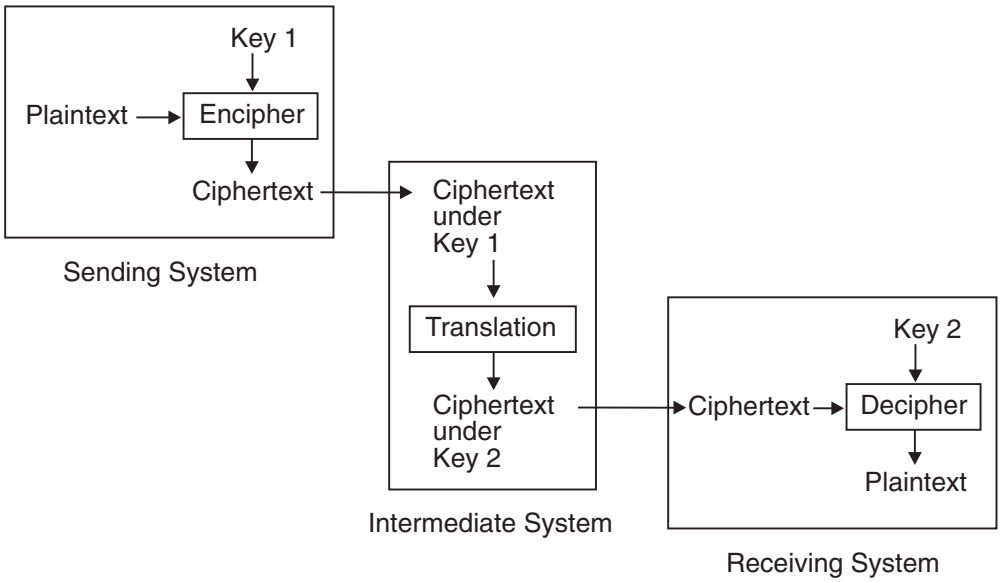

Figure 7. Data Protected When Sent between Intermediate Systems

In this situation, when you pass enciphered data to a system, you do not send a data-encrypting key to decipher the data at the receiving system. Instead, the systems establish pairs of data-encrypting and data-translation keys that exist on the systems. These keys encipher and reencipher the data. The data ends up enciphered under a data-encrypting key that exists on the receiving system. Transport keys may be needed to establish the data-encrypting keys and the data-translation keys on the systems.

Both the sending and receiving systems give data-translation keys to the intermediate system. On the intermediate system, a data-translation key from the sending system matches a data-encrypting key on the sending system. In Figure 7, this key is called *Key 1*. Also on the intermediate system, a data-translation key from the receiving system matches the data-encrypting key on the receiving system. In Figure 7, this key is called *Key 2*. Note that *Key 1* and *Key 2* do not have the same clear key value.

The data-translation keys cannot decipher data. They are used in the ciphertext translate callable service, which reenciphers data from protection under one key to protection under another key.

On the sending system, the plaintext is enciphered under *Key 1*, so it is ciphertext. Then the ciphertext is sent to the intermediate system. At the intermediate system, the data is reenciphered from under *Key 1* to under *Key 2* without appearing as plaintext. When the receiving system receives the ciphertext, the system can decipher the ciphertext from under *Key 2*, so it is plaintext.

Data-translation keys are also used when there is more than one intermediate system between the sending system and receiving system. The sending system and the first intermediate system share a data-encrypting/data-translation key pair. Each pair of neighboring intermediate systems shares a data-translation key pair. The final intermediate system and the receiving system share a data-translation/data-encrypting key pair.

Triple DES for Privacy

ICSF supports triple DES encryption for data privacy. This provides stronger encryption than the current DES algorithm and single-length DES data-encryption keys. Triple DES uses three, single-length keys to encipher and decipher the data which results in a stronger form of cryptography.

Data that has been encrypted under a double-length or triple-length DATA key cannot be reenciphered using data-translation keys as described in “Protection of Distributed Keys” on page 17.

Chapter 3. Managing Cryptographic Keys

To perform cryptographic services, you need to know how to create, maintain, and use cryptographic keys. This chapter gives an overview on entering master keys, generating keys, creating and maintaining the cryptographic key data sets (CKDS and PKDS), and entering keys into the CKDS. This chapter also discusses distributing keys and controlling access to keys, and presents a summary of key use.

Generating Cryptographic Keys

Using ICSF, you can generate keys by using either the key generator utility program (KGUP) or the key generate callable service. Both KGUP and the key generate callable service create all types of keys except PKA keys and ANSI X9.17 keys. KGUP stores the key that it generates in the CKDS. The key generate callable service returns the key to the application program that called it, instead of storing it in the CKDS. The application program can then call the dynamic CKDS update service to store the key in the CKDS.

Generating PKA Keys

If the PCI Cryptographic Coprocessor Feature (PCICC) is installed, ICSF is able to generate RSA keys using the PKA Key Generate service. The RSA key format can be the 1024 Modulus Exponent form or the Chinese Remainder form. Retained keys are RSA keys generated within the secure boundary of the PCICC and never leave the secure boundary. Only the domain that created the retained key can access it. Retained key format can be the 1024 Modulus Exponent form or the Chinese Remainder form. For more information on how to retain a generated key, see *OS/390 ICSF Application Programmer's Guide*.

Key Generator Utility Program (KGUP)

You can use KGUP to generate keys in either an operational form or an exportable form. When KGUP generates a key in the operational form, it stores it in the cryptographic key data set (CKDS). When KGUP generates a key in exportable form, you can send it to another system.

To specify the function that you want KGUP to perform, you use KGUP control statements. For a detailed description of how to use the program to generate keys, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213.

Key Generate Callable Service

The key generate callable service generates a single key or a pair of keys. Unlike KGUP, the key generate callable service does not store the keys in the CKDS but returns them to the application program that called the service. The application program can then call the dynamic CKDS update service to store the keys in the CKDS.

When you call the key generate callable service, you pass parameters that specify information about the key you want generated. The key generate callable service generates keys in the following possible forms:

- Operational, if the master key protects it
- Importable, if an importer key-encrypting key protects it
- Exportable, if an exporter key-encrypting key protects it

To use ICSF you need to enter master keys and operational keys. For more information about the key generate callable service, see the *OS/390 ICSF Application Programmer's Guide*.

Entering Keys

This section gives you an overview of key entry and the methods of key entry.

Entering Master Keys

Master keys are used to protect all cryptographic keys that are active on your system. The number and types of master keys you need to enter depends on your hardware configuration.

- On an ES/9000-9021 (bipolar) processor with the Integrated Cryptographic Feature (ICRF), a DES master key protects the DES keys used on the system.
- On the S/390 Enterprise Servers and S/390 Multiprise with Cryptographic Coprocessor Features, a DES master key protects DES keys and PKA master keys protect DSS and RSA keys.
- On the optional PCI Cryptographic Coprocessor, the symmetric-keys master key (SYM-MK) protects symmetric keys such as DES keys and the asymmetric-keys master key (ASYM-MK) protects RSA keys.

The first time you start ICSF on your system, you must enter master keys and initialize the cryptographic key data set (CKDS). You can then generate and enter the keys you use to perform cryptographic functions. The master keys you enter protect the keys stored in the CKDS and the PKDS.

Because master key protection is essential to the security of the other keys, ICSF stores the master keys within the secure hardware of the cryptographic feature. This nonvolatile key storage area is unaffected by system power outages, because it is protected by a battery power unit. The values of the master keys never appear in the clear outside the cryptographic feature.

Managing the master key involves the following tasks:

- Entering the master keys the first time you start ICSF
- Reentering the master keys if they are cleared
- Changing the DES master key periodically
- Changing the PKA master keys periodically

The types of master keys you can enter and the steps you take to enter master keys depend on your system processor and hardware features.

For either the S/390 Cryptographic Coprocessor Feature or the PCI Cryptographic Coprocessor, you can use any of the following methods to enter the master keys:

- Pass Phrase Initialization

  The pass phrase initialization utility allows the casual user of ICSF to set both the DES and PKA master keys on the S/390 Cryptographic Coprocessor Features, set the SYM-MK and ASYM-MK on the PCI Cryptographic

Coprocessors, and initialize the CKDS with a minimal effort. For steps in using the pass phrase initialization utility, refer to Chapter 4, “Using the Pass Phrase Initialization Utility” on page 47.

- Clear Master Key Entry panels

  The clear master key entry panels are enhanced ISPF panels through which you enter master key parts in the clear. You can use these panels to enter master key parts into both the S/390 Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessor. The master key parts appear briefly in the clear in MVS host storage within the address space of the TSO user before being transferred to the secure hardware. Within the boundaries of the secure hardware, the key parts are combined to produce the master key. The clear master key part entry panels provide a level of security for master key entry that is at least equivalent to that provided with CUSP and superior to that provided with PCF. Clear master key part entry is provided for installations where the security requirements do not warrant the additional expense and complexity of the optional TKE workstation. For clear master key entry steps on either the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise, refer to Chapter 5, “Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise” on page 57. For clear master key entry steps on the PCI Cryptographic Coprocessor, refer to Chapter 6, “Managing Master Keys on the S/390 Enterprise Server with PCI Cryptographic Coprocessors” on page 89.

- Trusted Key Entry (TKE) workstation

  The TKE workstation is an optional hardware feature available from IBM Customized Solutions. The TKE workstation uses a variety of public key cryptographic techniques to ensure both the integrity and privacy of the logically secure master key transfer channel. It provides security that is equivalent to the physically secure connection between the key entry unit and the key storage unit of the ICRF available on bipolar processors. You can use a single TKE workstation to set up master keys in all Cryptographic Coprocessor Features and PCI Cryptographic Coprocessors within a server complex with no manual intervention. For information on using the TKE workstation, see *OS/390 ICSF TKE Workstation User's Guide* or *OS/390 ICSF TKE Workstation User's Guide 2000*.

If you are using an ES/9000-9021 (bipolar) processor, you can enter only a DES master key. You enter the DES master key by using the ICSF master key panels and the ICRF hardware. Refer to Chapter 7, “Managing the Master Key and Operational Keys on the ES/9000-9021 (Bipolar) Processor” on page 131 for master key entry steps on bipolar processors.

After you have entered the master keys, you choose options on the ICSF Initialize a CKDS panel to do the following:

- Create the CKDS header record.
- Activate the DES master key and read the CKDS into storage.
- Create keys that ICSF uses for internal processing, and read the CKDS into storage again.

Some servers or processor models may have up to two cryptographic features. If your system has two cryptographic features accessed by the same operating system, the master keys must be the same in both.

Entering System Keys into the Cryptographic Key Data Set (CKDS)

The ICSF CKDS has several sets of system keys. These are the keys with labelname of X'00' and are installed during CKDS initialization. The system keys are required in the CKDS. Other keys are optional; however, their absence will affect functions in many services.

If the system keys are not in the CKDS, an 18F abnormal end with reason code X'A1' can occur. If the ANSI, NOCV enablement, or the ESYS keys are not in the CKDS, an 18F abnormal end with reason code X'A3' can occur.

The following is a summarization of where the keys are used:

- Required System Keys

  These keys are used to validate CKDS entries and used in many services. These keys are required.

- NOCV-enablement Keys
  - These keys are needed for all services where NOCV key-encrypting keys are required. See the *OS/390 ICSF Application Programmer's Guide* for more information.
  - These keys are needed in CSNBKGN and KGUP where replicated keys are generated, that is, where key length of SINGLE is specified for double-length keys.
  - These keys are used during VP generation on a CDMF-only system.
  - These keys are used by CSNBSBC on a CDMF-only system.
  - These keys are used during CKDS conversion.
  - These keys are required to export and import double-length DATAM and DATAMV keys.

    Note: To import and export double-length DATAM and DATAMV keys, you must first reinstall the NOCV-enablement keys in the CKDS and then refresh the CKDS. For information on creating the NOCV-enablement keys, refer to step 2e in “Initializing the CKDS at First-Time Startup” on page 74. For information on refreshing a CKDS refer to “Refreshing the CKDS at Any Time” on page 76.

- ANSI System Keys
  - These keys are needed to use the ANSI callable services and require ES/9000-711 hardware or above. See the *OS/390 ICSF Application Programmer's Guide* for more information. If you are not on the required hardware, we recommend that you NOT add these keys.
  - These keys are used by CSNBSBD on a CDMF-only system.
  - These keys are used when installing the extended system keys (ESYS) on the CKDS initialization panel.
  - These keys are required to generate double-length DATAM and DATAMV keys in the importable form.

    Note: To generate double-length DATAM and DATAMV keys, you must first reinstall the ANSI system keys in the CKDS and then refresh the CKDS. For information on creating the ANSI system keys, refer to step 2f in “Initializing the CKDS at First-Time Startup” on

page 74. For information on refreshing a CKDS refer to “Refreshing the CKDS at Any Time” on page 76.

- Extended System Keys

  These keys require the CMOS processors (S/390 G3 Enterprise Server, or higher or the S/390 Multiprise). They are required for symmetric key export. If you are not on the required hardware, we recommend that you NOT add these keys.

Entering Keys into the Cryptographic Key Data Set (CKDS)

All DES keys except the DES master key can be stored in the CKDS. There are several methods you can use to enter keys into the CKDS.

- Key generator utility program (KGUP)

  Regardless of your processor or server model, you can use KGUP to enter keys into the CKDS.

- Dynamic CKDS update callable services

  Regardless of your processor or server model, you can program applications to use the dynamic CKDS update callable services to enter keys into the CKDS.

- Key entry hardware

  On ES/9000-9021 (bipolar) processors operational keys can be entered directly using the key entry hardware that is installed on your key storage unit (KSU).

- Trusted Key Entry (TKE) workstation

  With the TKE workstation, available as an option with the S/390 G3 and higher Enterprise Servers and S/390 Multiprise, you can load key parts for operational (PIN and transport) keys into a key queue. To load these key parts into the CKDS, you must also use the ICSF Operational Key panel and perform a CKDS refresh. For more information, refer to the *OS/390 ICSF TKE Workstation User's Guide* or *OS/390 ICSF TKE Workstation User's Guide 2000*.

The table in Figure 8 shows which keys can be entered by each of these methods.

Figure 8. Methods for Entering Each Key Type into the CKDS

Key Type	KGUP	Dynamic Update	TKE Workstation	KSU
PIN	X	X	X	X
Importer and Exporter key-encrypting keys	X	X	X	X
Data-encrypting	X	X		
Data-translation	X	X		
MAC and MACVER	X	X		
DATAM and DATAMV	X	X		
ANSI key-encrypting keys		X		
IMP-PKA keys		X	X	

Entering Keys by Using the Key Generator Utility Program

One function that KGUP performs is to enter key values that you supply into the CKDS. You can enter a clear or encrypted key value by using KGUP.

You submit KGUP control statements to specify to KGUP the function that you want KGUP to perform. To enter a key, you specify the key value in a KGUP control statement. You can either specify an encrypted or clear key value.

When you enter an encrypted key value, the key value must be encrypted under an importer key-encrypting key that exists in the CKDS. You use the KGUP control statement to specify which importer key-encrypting key encrypts the key. KGUP reenciphers the key from under the importer key-encrypting key to under the master key and places the key in the CKDS.

When you enter a clear key value, KGUP enciphers the clear key value under the master key and places the key in the CKDS. Because entering clear keys may endanger security, ICSF must be in special secure mode before you can enter a clear key by using KGUP. Special secure mode lowers the security of your system to allow you to use KGUP to enter clear keys, and to produce clear PINs.

To use special secure mode, several conditions must be met.

- The installation options data set must specify YES for the SSM installation option.

  For information about specifying installation options, see the *OS/390 ICSF System Programmer's Guide*.

- The environmental control mask (ECM) must be configured to permit special secure mode.

  The ECM is a 32-bit mask that is defined for each crypto domain during hardware installation. The second bit in this mask must have been turned on to enable special secure mode.

- If you are running in LPAR mode, special secure mode must be enabled

  On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, you enable special secure mode during activation using the Crypto page of the Customize Activation Profiles task. After activation, you can enable or disable special secure mode on the Change LPAR Crypto task. Both of these tasks can be accessed from the Hardware Master Console.

  On the bipolar processor, special secure mode is enabled through the LPSEC panel.

If these conditions permit the use of special secure mode, it is enabled automatically on the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise when you specify that you are entering clear key values in a KGUP statement. On bipolar processors, an additional step must be taken to enable special secure mode; you must turn a brass key in a switch on the KSU.

For a detailed description of how to use KGUP to enter keys, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213.

Entering Keys by Using the Dynamic CKDS Update Services

ICSF provides a set of callable services that allow applications to dynamically update the CKDS. Applications can use these services to create, write, and delete records from the CKDS. These dynamic updates affect both the DASD copy of the CKDS currently in use and the in-storage copy. Another service allows an application to retrieve the key token from a record in the in-storage CKDS. That token can be used directly in subsequent CALLs to cryptographic services. The key part import callable service combines the clear key parts of an AKEK and returns the key value either in an internal key token or as a dynamic update to the CKDS. For more information on using the dynamic CKDS update services or the key part import service, refer to the *OS/390 ICSF Application Programmer's Guide*.

Entering Keys Directly by Using the Key Entry Hardware

There are several ways to enter keys directly into the ICSF hardware. The choice depends on the type of key entry hardware that is installed on your processor. If you have an S/390 G3 Enterprise Server, or higher or the S/390 Multiprise, you may have the optional TKE workstation installed and can use this for key entry. If you have a bipolar processor, your key entry hardware depends on the version of Integrated Cryptographic Feature that is installed on your processor. To determine which version you have, refer to “Using the KSU” on page 139. If you have an ICRF with keypad and Personal Security card reader, you can enter keys in either of two ways:

- Reading the key parts from Personal Security cards inserted into the KSU card reader
- Manually entering the key parts using the keypad on the KSU

If you have an ICRF with hand-held key-entry unit, you enter key parts manually using the hand-held KEU. You can enter clear PIN keys or clear transport keys into the CKDS by using the key entry hardware and the ICSF panels. You can enter a clear key in multiple parts that ICSF combines to create the key. ICSF enters the key into the CKDS without calling KGUP. For detailed information about entering operational keys into the CKDS, see “Entering Operational Keys” on page 186.

Entering Keys into the PKDS

You can store RSA and DSS public and private keys in the PKA key data set (PKDS). ICSF provides a set of callable services that allow applications to update the PKDS. Applications can use some of these services to create, write, and delete records from the PKDS. For more information on using the PKDS update services, refer to the *OS/390 ICSF Application Programmer's Guide*.

Maintaining Cryptographic Keys

You can use either KGUP or the dynamic CKDS update services to generate and enter keys into the cryptographic key data set (CKDS), or to maintain keys already existing in the CKDS. The keys are stored in records. A record exists for each key that is stored in the CKDS.

A record in the CKDS is called a *key entry* and has a label associated with it. When you call some ICSF callable services, you specify a key label as a parameter to identify the key for the callable service to use.

Use KGUP to change the key value of an entry, rename entry labels, and delete entries in the CKDS. For more information about how to use KGUP to update key entries in the CKDS, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213.

Use the dynamic CKDS update services in applications to create entries, change the key value of an entry, and delete entries in the CKDS.

You can use RACF to control which applications can use specific keys and services. For more information, see “Controlling Who Can Use Cryptographic Keys and Services” on page 40.

Setting Up and Maintaining the Cryptographic Key Data Set (CKDS)

The cryptographic key data set (CKDS) stores operational keys of all types. It contains an entry for each key.

Note: PKA keys are stored in the PKA key data set (PKDS) and not in the CKDS.

Keys that are stored in the CKDS are encrypted under the appropriate variants of the DES master key. Before you generate keys that you store in the CKDS, you must define a DES master key to your system. You define a master key by entering its value and setting it so it is active on the system. After you enter the master key, you must make it active on the system by setting it when you initialize the CKDS. For information about entering and setting the master key and initializing CKDS on either the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise, see Chapter 5, “Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise” on page 57 and Chapter 6, “Managing Master Keys on the S/390 Enterprise Server with PCI Cryptographic Coprocessors” on page 89. For information about entering and setting the master key and initializing the CKDS on a bipolar processor, see Chapter 7, “Managing the Master Key and Operational Keys on the ES/9000-9021 (Bipolar) Processor” on page 131.

Once you define a master key, you generate keys and store them in the CKDS. You use KGUP to generate keys and change key values and other information for a key entry in the CKDS. For more information about running KGUP, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213. You can also program applications to use callable services to generate keys and change key information in the CKDS. For more information about how to use callable services to update key entries in the CKDS, see the *OS/390 ICSF Application Programmer's Guide*. You can use the optional TKE workstation (available with the S/390 G3 Enterprise Server, or higher and the S/390 Multiprise) to load key parts for operational (PIN and transport) keys into a key queue through a secure logical channel. To load these key parts into the CKDS, you must also use the ICSF Operational Key panel and perform a CKDS refresh. For more information on using the TKE workstation, see the *OS/390 ICSF TKE Workstation User's Guide*.

When you initialize ICSF, the system obtains space in storage for the CKDS. For more information about initializing space for the CKDS, see the *OS/390 ICSF System Programmer's Guide*.

Besides the in-storage CKDS, there is a copy of the CKDS on disk. Your installation can have many disk copies of CKDSs, backup copies, and different disk

copies. For example, an installation may have a separate CKDS with different keys for each shift. When a certain shift is working, you can load the CKDS for that shift into storage. Then only the keys in the CKDS loaded for that shift can be accessed for ICSF functions. However, only one disk copy is read into storage at a time.

You use KGUP to make changes to any disk copy of the CKDS. When you use KGUP to generate and maintain keys, or enter keys directly into the KSU, you change only the disk copy of a CKDS. Therefore, you can change keys in the disk copy of the data set without disturbing ICSF functions that are using the keys in the in-storage copy of the data set. To make the changes to the disk copy of the CKDS active, you need to replace the in-storage CKDS using the refresh utility. When you use the dynamic CKDS update callable services to change entries in the CKDS, you change both the in-storage copy of the CKDS and the disk copy. This allows for the immediate use of the new keys without an intervening refresh of the entire CKDS. Figure 9 shows that ICSF callable services use keys in the in-storage copy of the CKDS.

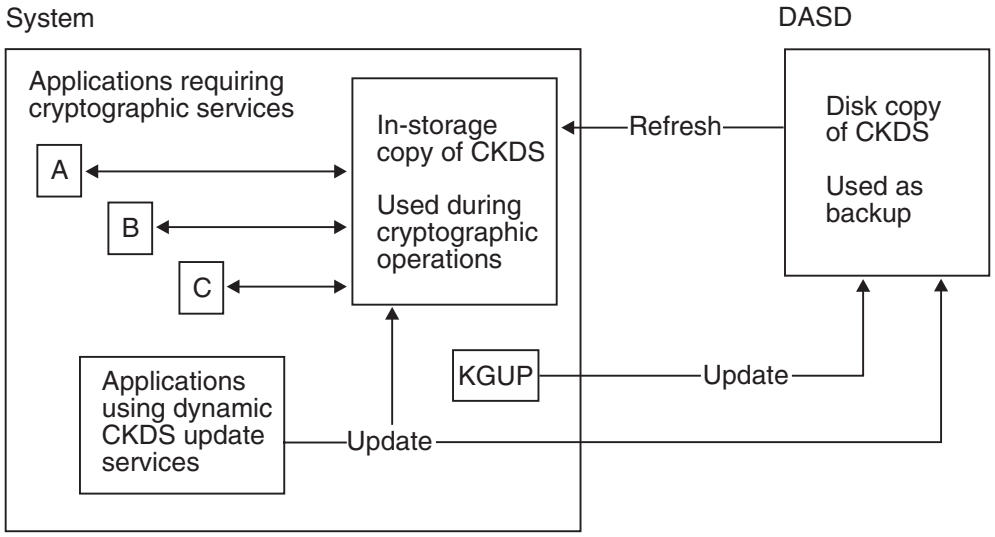

Figure 9. Updating the In-Storage Copy and the Disk Copy of the CKDS

You just specify the name of the disk copy of the CKDS when you run KGUP. You can also read any disk copy of the CKDS into storage, by specifying the name of the disk copy of the CKDS on a Refresh In-Storage CKDS panel. You can also run a utility program to read a disk copy of the CKDS into storage. However, the disk copy must be enciphered under the correct master key. All the copies of your disk copies of the CKDS should be enciphered under the same master key.

Your installation should periodically change the master key. To change the master key, you enter a new master key value and make that value active. The keys in a CKDS must then be enciphered under the new master key. Therefore, before you make the new master key active, the CKDS must be reenciphered from under the current master key to under the new master key.

First, you reencipher the disk copy of the CKDS under the new master key. Then you activate the new master key using the change master key option. This option automatically replaces the old in-storage CKDS with the disk copy that is reenciphered under the new master key. If you have multiple disk copies of CKDSs, reencipher all of them under the new master key before changing the master key.

You can reencipher a CKDS under a new master key by using the master key panels or a utility program. For more information about reenciphering a CKDS on an S/390 G3 Enterprise Server, or higher or a S/390 Multiprise, see “Changing the Master Key Using the Master Key Panels” on page 81 and “Changing the Master Key Using the Master Key Panels” on page 122. For more information about reenciphering a CKDS on a bipolar processor, see “Changing the Master Key Using the Master Key Panels” on page 183.

Note: When you perform any functions that affect the in-storage copy of the CKDS, you should consider temporarily disallowing the dynamic CKDS update services. Functions that affect the in-storage copy of the CKDS include changing the master key, reenciphering, or refreshing. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

Managing the CKDS in a SYSPLEX Environment

ICSF is supported in a SYSPLEX environment. The CKDS may be shared across systems in a SYSPLEX environment. The systems may be different LPARs on the same system or different systems across multiple S/390 Processors. The only requirement for sharing the CKDS is that the same DES Master Key be installed on all systems sharing that CKDS. It is not required to share the CKDS across a SYSPLEX. Each system may have its own DES Master Key and its own CKDS. A SYSPLEX may have a combination of systems that share a CKDS and individual systems with separate CKDSs.

When sharing the CKDS, a few precautions should be observed:

- Dynamic CKDS services update the DASD copy of the CKDS and the in-storage copy on the system where it is run. There is no SYSPLEX broadcast of the update. In order to update the in-storage copy of all images that share the CKDS, you must perform a CKDS REFRESH on each image. This can be done by using either the TSO panels or the CSFEUTIL utility.
- The CKDS may be shared between ICSF V1.2 and ICSF V2.1 (OS/390 ICSF) systems. However, you must take care when reenciphering the CKDS. ICSF V1.2 does not support the new key types that were introduced in ICSF V2.1. When performing a master key change, you must first change the master key on the ICSF V2.1 system. You must also reencipher the CKDS on the ICSF V2.1 system. This is because the reencipher function on the ICSF V1.2 system does not recognize the new key types and will abend.
- Changing master keys should be done with care in a SYSPLEX environment. Follow the procedure in “Changing Master Keys” on page 79 for master key change on an image with the latest level of ICSF, reenciphering the CKDS into a new data set. On the other images, enter the new master key; reenciphering the CKDS is not necessary. Then perform the Change master key option by using the new CKDS. During the master key change across a SYSPLEX there should not be any applications that pass internal tokens from one image to another.

Setting Up and Maintaining the PKDS

RSA and DSS public and private keys can be stored in the PKA key data set (PKDS), a VSAM data set. The PKDS is maintained as an external data set only. There is no need to maintain a copy of the PKDS data set in main storage as PKA keys are accessed infrequently and impossible to reencipher. Applications can use the dynamic PKDS callable services to create, write, read and delete PKDS records.

The PKDS is automatically initialized at ICSF startup. There are internal and external tokens in the PKDS. External tokens may be used irrespective of the PKA master keys. Internal tokens, however, can only be used if they are encrypted under the current PKA signature master key (SMK), the key management master key (KMMK), or the asymmetric-keys master key (ASYM-MK).

Changing PKA master keys should be done with care. In order to be usable, any internal tokens in the PKDS will need to re-created after the PKA master key change. For information on initializing the PKDS, see *OS/390 ICSF System Programmer's Guide*. Also see “Changing the PKA Master Keys” on page 84 for information on the keys.

You can program applications to use the PKDS callable services to create entries, change entries and delete entries in the PKDS. For more information about how to use callable services to update key entries in the PKDS, see the *OS/390 ICSF Application Programmer's Guide*.

Managing the PKDS in a SYSPLEX Environment

ICSF is supported in a SYSPLEX environment. As with the CKDS, the PKDS may be shared across systems in a SYSPLEX. There is a requirement that the SMK and KMMK be the same on all systems sharing the PKDS. Since there is no in-storage copy of the PKDS, all access to the PKDS is to the shared DASD copy. There are implications to sharing the PKDS across multiple levels of ICSF. Refer to *OS/390 ICSF System Programmer's Guide*.

If you have created retained keys and if you are sharing the PKDS with levels of ICSF that do not support retained keys, there are special considerations to consider. You will need to apply a PTF on your older systems to prevent the PKA callable services from updating or deleting a retained key. You should also be aware that the new format RSA key tokens (X'06 Modulus Exponent form and X'08' Chinese Remainder form) are not supported on pre-V2R9 systems.

Distributing Cryptographic Keys

With ICSF you can develop key distribution systems as defined in any of the following:

- The IBM Common Cryptographic Architecture
- The ANSI X9.17 Standard
- The Public Key Cryptographic Standard

These key distribution systems are explained in the following sections.

Common Cryptographic Architecture Key Distribution

ICSF provides protection for keys when the keys are sent outside your system. You must generate complementary keys for key distribution. A complementary pair of keys has the following characteristics:

- The keys have the same clear key value.
- The key types are different but complementary.
- Each key usually exists on a different system.

Complementary keys are the following types:

- Importer key-encrypting key and exporter key-encrypting key (transport keys)
- PIN generation key and PIN verification key
- Input PIN-encrypting key and output PIN-encrypting key
- MAC generation key and MAC verification key
- Data-encrypting key and data-translation key

When protected data is sent between intermediate systems, the following keys exist as complementary keys. For more information about this situation, see “Protection of Data” on page 20.

- Data-encrypting key and data-translation key
- Data-translation key and data-translation key

The same data-encrypting key can also exist on two different systems so that both systems can encipher and decipher the data.

You can use ICSF to protect keys that are distributed across networks. You distribute keys across a network for some of the following reasons:

- When you send encrypted data to another system, you send the data-encrypting key with the data or before it.
- When you share complementary keys with another system.

Transport keys protect keys being sent to another system. When a key leaves your system, an exporter key-encrypting key encrypts the key. When another system receives the key, the key is still encrypted under the same key-encrypting key, but the key-encrypting key is now considered an importer key-encrypting key. The exporter key-encrypting key at the sending system and the importer key-encrypting key at the receiving system must have the same clear value. Before two systems can exchange keys, they must establish pairs of transport keys.

In Figure 10 on page 35 System A wants to send an output PIN-encrypting key to System B.

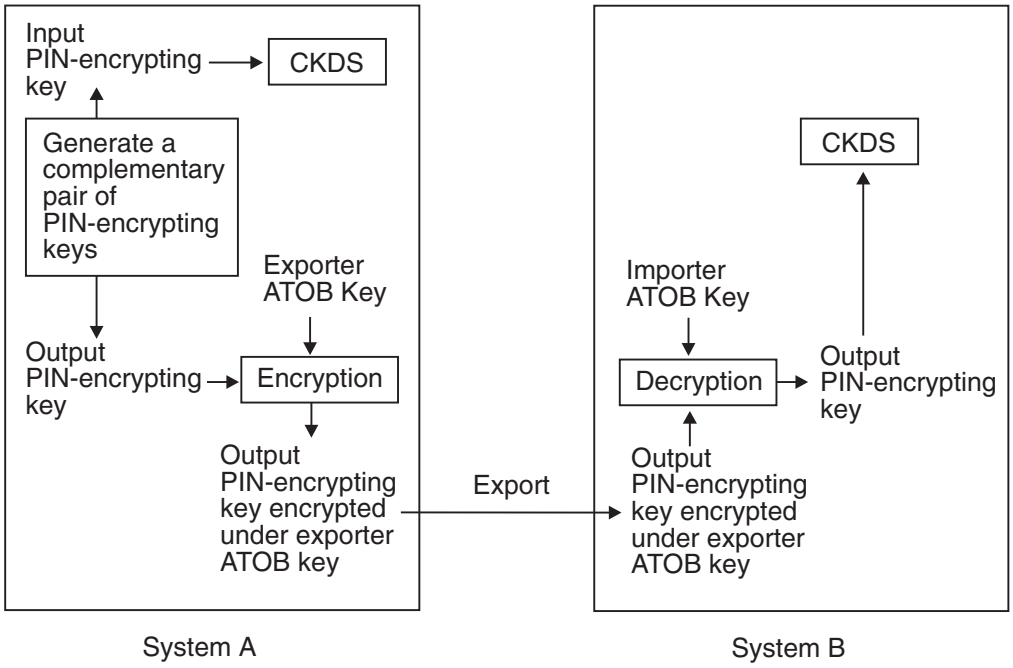

Figure 10. Key Sent from System A to System B

Before sending the key, System A and System B must establish a pair of transport keys between them. System A has an exporter key-encrypting key called Exporter ATOB, which has the same key value as the importer key-encrypting key called Importer ATOB at System B. This pair of transport keys is unidirectional, because they are used only for distributing keys from System A to System B.

When System A generates the input PIN-encrypting key, the system also creates a complementary output PIN-encrypting key. System A enciphers the input PIN-encrypting key under System A's master key and stores the input PIN-encrypting key in the CKDS. It encrypts the complementary output PIN-encrypting key under the Exporter ATOB key so it can send the output PIN-encrypting key to System B. System B decrypts the output PIN-encrypting key using the Importer ATOB key, and encrypts the output PIN-encrypting key under System B's master key.

For the systems to send keys in both directions, they must establish two pairs of transport keys at each site, as in Figure 11.

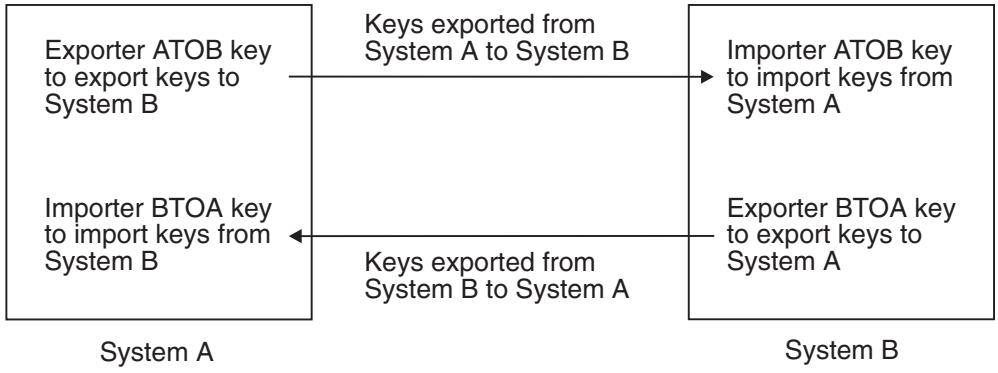

Figure 11. Keys Sent between System A and System B

To send keys from System A to System B, use the key generator utility program (KGUP) to establish an importer and exporter complementary key pair. You establish an exporter key, Exporter ATOB key, on System A and establish the complementary importer key, Importer ATOB key, on System B. Then when System A sends a key to System B, System A sends the key in exportable form encrypted under Exporter ATOB key. When System B receives the key, System B considers the key in importable form encrypted under Importer ATOB key.

To send keys from System B to System A, use KGUP to establish an importer and exporter complementary key pair. You establish an exporter key, Exporter BTOA key, on System B and the complementary importer key, Importer BTOA key, on System A. When System B sends a key to System A, System B sends the key in exportable form encrypted under Exporter BTOA key. When System A receives the key, System A considers the key in importable form encrypted under Importer BTOA key.

KGUP can create a pair of complementary keys, one key in operational form, and its complement in exportable form. You can also use KGUP to receive keys that are in importable form. When you want KGUP to create a key value in exportable form or import a key value in importable form, you specify the transport key that encrypts the key value. For more information about using KGUP for key distribution, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213.

You can also use one of two callable services to reencipher a key from operational form into exportable form. Both the key export callable service and the data key export callable service reencipher a key from encryption under the master key to encryption under an exporter key-encrypting key.

You can call the key import callable service to convert a key from importable form to operational form. The key import callable service reenciphers a key from encryption under an importer key-encrypting key to encryption under the system's master key.

With interlinked computer networks, sensitive data passes through multiple nodes before reaching its final destination. The originator and the receiver do not share a common key. Data-translation keys are shared between the originator and an intermediate system, between two intermediate systems, and between an intermediate system and the receiver system. As the data is passed along between these systems, they must reencipher it under the different data-translation keys without it ever appearing in the clear. Each system can call the ciphertext translate callable service to do this function. For a description of sending data between intermediate systems, see “Protection of Data” on page 20.

ANSI X9.17 Key Distribution

ICSF provides callable services that allow you to develop key distribution systems that adhere to the ANSI X9.17 standard.

When protected data is sent between two systems, it is protected by data-encrypting keys. The same data-encrypting key exists on two different systems so that both systems can encipher and decipher the data.

Before two systems can exchange keys, they must establish a shared transport key, the ANSI key-encrypting key (AKEK), which is distributed manually. This

transport key is bidirectional, and can be used for distributing keys in both directions between System A and System B, as shown in Figure 12 on page 37.

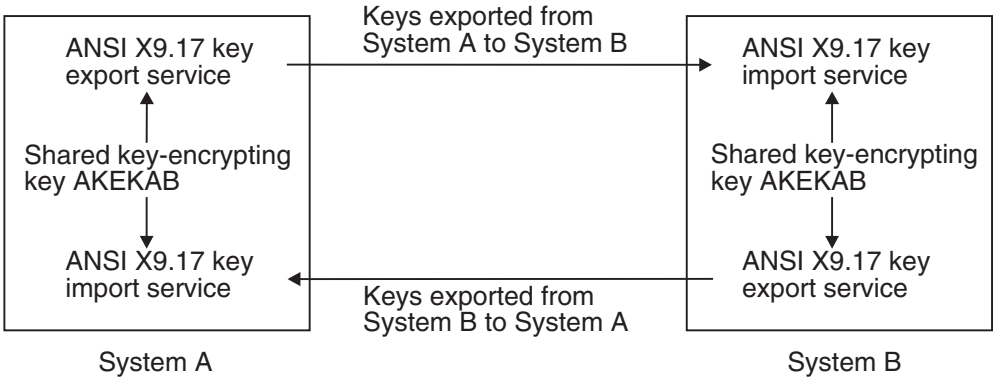

Figure 12. ANSI X9.17 Keys Sent between System A and System B

System A generates the data-encrypting key, enciphers it under System A's master key, and stores it in the CKDS. System A uses the ANSI X9.17 key export callable service to encrypt the data-encrypting key under the shared transport key, AKEKAB, and export it to System B. System B then uses the ANSI X9.17 key import callable service to decrypt the data-encrypting key using the shared transport key, AKEKAB, and then encrypts it under System B's master key. The shared transport key is coupled with source and destination identifiers for System A and System B, and a message counter as defined in the ANSI offset and notarization processes.

The shared ANSI key-encrypting key is bidirectional. System B can also send keys to System A. The systems can also exchange data keys along with the AKEK used to encrypt them. The AKEKs are themselves encrypted under the transport AKEK.

ANSI X9.17 key distribution can take place in several types of environments:

- Point-to-point environment
- Key distribution center environment
- Key translation center environment

For more information on ANSI X9.17 key distribution, refer to the ANSI X9.17 Standard.

Public Key Cryptographic Standard Key Distribution

OS/390 ICSF provides support for the Public Key Cryptographic Standard (PKCS). PKSC is a set of standards for public-key cryptography developed by RSA Data Security, Inc. An example of using RSA public-key cryptography to distribute DES and CDMF data-encrypting keys is presented in “Using RSA Public Keys to Protect Keys Sent between Systems” on page 19.

Summary of Key Use

Figure 13 on page 38 summarizes the use of keys for different cryptographic functions. For each cryptographic function, the table identifies the type of key or keys you can use and the callable service an application can call to perform the task.

Note: For the following services, you do not need a key:

- Character/nibble conversion (CSNBXBC and CSNBXCB)
- Code conversion (CSNBXAE and CSNBXEA)
- Decode (CSNBDCO)
- Encode (CSNBECO)
- Modification detection code generate (CSNBMDG and CSNBMDG1)
- One-way hash generate (CSNBOWH and CSNBOWH1)
- Random number generate (CSNBRNG)
- X9.9 data editing (CSNB9ED)

Figure 13 (Page 1 of 2). Summary of Key Use

Cryptographic Function	Required Key	Callable Service
Convert any non-ANSI key from operational form into exportable form	• Internal key token • Exporter key-encrypting key	Key export
Convert a data key from operational form into exportable form	• Internal key token • Exporter key-encrypting key	Data key export
Convert a non-ANSI key from importable form into operational form	• External key token • Importer key-encrypting key	Key import
Convert a clear data key into operational form	• Clear data key	Clear key import Multiple clear key import
Convert any clear non-ANSI key into importable or operational form	• Clear key • Importer key-encrypting key	Secure key import Multiple secure key import
Decipher data	• Encrypted data-encrypting key for decipher	Decipher
	• Clear data-encrypting key for decipher	Decode
Encipher data	• Encrypted data-encrypting key for encipher	Encipher
	• Clear data-encrypting key for encipher	Encode
Extract a PKA public key from a PKA private key token	• PKA private key token	PKA public key extract
Generate a clear VISA PIN validation value from an encrypted PIN block	• Input PIN-encrypting key or • Output PIN-encrypting key	Clear PIN generate alternate
Generate a digital signature	• PKA private key	Digital signature generate
Generate a message authentication code	• MAC generation key or • Data-encrypting key	MAC generate
Generate single-length and double-length MAC keys	• Exporter key-encrypting key	User derived key

Figure 13 (Page 2 of 2). Summary of Key Use

Cryptographic Function	Required Key	Callable Service
Generate PINs	• PIN generation key	PIN generate Clear PIN generate alternate
Generate a symmetric key in two forms (DES-encrypted and PKA public key-encrypted)	• Key-encrypting key (optional) • RSA public key	Symmetric key generate
Generate or verify secure verification patterns for keys	• Key-encrypting key	Key test Key test extended
Import, export, or translate keys according to the ANSI X9.17 standard	• ANSI key-encrypting key	ANSI X9.17 key import ANSI X9.17 key export ANSI X9.17 key translate Key part import
Import an encrypted PKA private key	• External PKA key token • Importer key-encrypting key	PKA key import
Import a DES data-encrypting key enciphered under an RSA public key	• DES data-encrypting key protected under an RSA public key • Corresponding RSA private key	Symmetric key import
Prohibit the export of an external key token from a receiving node	• Exporter key-encrypting key	Prohibit export extended
Transform a CDMF data-encrypting key to a transformed, shortened DES data-encrypting key	• Data-encrypting key	Transform CDMF key
Translate text from one data key to another in a multiple system network	• Data-translation key1 • Data-translation key2	Ciphertext translate
Verify a digital signature	• PKA public key	Digital signature verify
Verify a message authentication code	• MAC verification key or • Data-encrypting key or • MAC generation key	MAC verify
Verify PINs	• PIN verification key • Input PIN-encrypting key	PIN verify
Translate PINs	• Input PIN-encrypting key • Output PIN-encrypting key	PIN translate

Controlling Who Can Use Cryptographic Keys and Services

You can use the OS/390 Security Server (RACF), to control which applications can use specific keys and services. This can help you ensure that keys and services are used only by authorized users and jobs. You can also use RACF to audit the use of keys and services.

To set up these controls, create and maintain RACF general resource profiles in the CSFKEYS class, and in the CSFSERV class. The CSFKEYS class controls access to cryptographic keys, and the CSFSERV class controls access to ICSF services

If you are not the RACF security administrator, you need to ask for assistance from that person. To use the auditing capabilities of RACF, you need to ask for reports from a RACF auditor. Your installation's security plan should show who is responsible for maintaining these RACF profiles and auditing their use.

The following procedure describes one approach to doing this:

1. Decide whether you will protect keys, services, or both. You can select which keys and services to protect.
2. You may want to organize the users who need access to ICSF keys and services into groups. To do this, obtain a list of the user IDs of users who need to use ICSF keys and services. If batch jobs or started tasks need to use ICSF, obtain the user IDs under which they will run.

   Group any of the user IDs together if they require access to the same keys and services. For example, you might want to set up groups as follows:

   - Users who work with MAC-related callable services
   - Users who work with PIN-related callable services
   - Users who work with a particular MAC, or a particular PIN
   - Users who call applications to dynamically update the CKDS

   Usually, all users of ICSF should have access to keys and services by virtue of their membership in one of these RACF groups, rather than specific users. This is because RACF maintains the access lists in in-storage profiles. When the in-storage profiles are created or changed, the in-storage profiles must be refreshed. (Merely changing them in the RACF data base is not sufficient. This is analogous to the in-storage CKDS maintained by ICSF.) To refresh the in-storage RACF profiles, the RACF security administrator must use the SETROPTS command:

   ```
   SETROPTS RACLIST(CSFKEYS) REFRESH

   SETROPTS RACLIST(CSFSERV) REFRESH
   ```

   If you place *RACF groups* in the access lists of the RACF profiles, you can change a user's access to the protected services and keys by adding or removing the user from the groups. Ask your RACF security administrator to create the RACF groups.

   You should also ask your RACF security administrator to connect you to these groups with CONNECT group authority. This permits you to connect and remove users from the groups.

   For example, the security administrator could issue the following commands:

```
ADDGROUP groupid

CONNECT  your-userid  GROUP(groupid)  AUTHORITY(CONNECT)
```

With CONNECT group authority, you are able to connect other users to the groups:

```
CONNECT  other-userid  GROUP(groupid)
```

With CONNECT group authority, you are also able to remove users from the groups:

```
REMOVE  other-userid  GROUP(groupid)
```

3. Ask your RACF security administrator for the authority to create and maintain profiles in the CSFKEYS and CSFSERV general resource classes. Usually, this is done by assigning a user the CLAUTH (class authority) attribute in the specified classes. For example, the security administrator can issue the following command:

   ```
   ALTUSER  your-userid  CLAUTH(CSFKEYS CSFSERV)
   ```

4. If you want to use generic profiles that contain characters such as * and %, ask your RACF security administrator to activate generic profile checking in the CSFKEYS and CSFSERV classes:

   ```
   SETROPTS  GENERIC(CSFKEYS CSFSERV)
   ```

   Note: Using generic profiles has several advantages. Using generic profiles you can reduce the number of profiles that you need to maintain. You can also create a "top" generic profile that can be used to protect all keys and services that are not protected by a more specific profile.

5. Define profiles in the CSFKEYS and CSFSERV classes. For further instructions, see "Setting Up Profiles in the CSFKEYS General Resource Class" and "Setting Up Profiles in the CSFSERV General Resource Class" on page 42.

Setting Up Profiles in the CSFKEYS General Resource Class

To set up profiles in the CSFKEYS general resource class, take the following steps:

1. Define appropriate profiles in the CSFKEYS class:

   ```
   RDEFINE  CSFKEYS label  UACC(NONE)
            other-optional-operands
   ```

   where *label* is the label by which the key is defined in the CKDS or PKDS (this is not the transport key label). Note that if an application uses a token instead of a key label, no authorization checking is done on the use of the key.

   Notes:

   a. If you have ICSF/MVS Version 1 Release 1 profiles that specify *key-type.label*, you need to change them to specify only *label*.

   b. As with any RACF profile, if you want to change the profile later, use the RALTER command. To change the access list, use the PERMIT command as described in the next step.

   c. If you have already started ICSF, you need to refresh the in-storage profiles. See Step 3.

d. You can specify other operands, such as auditing (AUDIT operand), on the RDEFINE or RALTER commands. The NOTIFY operand is ignored when specified for profiles in the CSFKEYS class.

e. If the RACF security administrator has activated generic profile checking for the CSFKEYS class, you can create generic profiles using the generic characters * and %. This is the same as any RACF general resource class.

2. Give appropriate users (preferably groups) access to the profiles:

```
PERMIT  profile-name  CLASS(CSFKEYS)
        ID(groupid)  ACCESS(READ)
```

3. When the profiles are ready to be used, ask the RACF security administrator to activate the CSFKEYS class and refresh the in-storage RACF profiles:

```
SETROPTS  CLASSACT(CSFKEYS)

SETROPTS RACLIST(CSFKEYS) REFRESH
```

Setting Up Profiles in the CSFSERV General Resource Class

To set up profiles in the CSFSERV general resource class, take the following steps:

1. Define appropriate profiles in the CSFSERV class:

```
RDEFINE  CSFSERV service-name  UACC(NONE)
         other-optional-operands
```

Where *service-name* is one of the following:

CSFAEGN ANSI X9.17 EDC generate callable service

CSFAKEX ANSI X9.17 key export callable service

CSFAKIM ANSI X9.17 key import callable service

CSFAKTR ANSI X9.17 key translate callable service

CSFATKN ANSI X9.17 key transport key partial notarize callable service

CSFCKI Clear key import callable service

CSFCKM Multiple Clear Key Import

CSFCMK Change master key panel service

CSFCPA Clear PIN generate alternate

CSFCSG VISA CVV Service Generate

CSFCSV VISA CVV Service Verify

CSFCTT Cipher text translate callable service

CSFCTT1 Cipher text translate (with ALET) callable service

CSFDCO Decode callable service

CSFDEC Decipher callable service

CSFDEC1 Decipher (with ALET) callable service

| **CSFDKCS** Clear master key entry panel service (PCICC)

CSFDKEF Clear master key entry panel service (CCF)

CSFDKX Data key export callable service

CSFDSG Digital signature generate callable service

CSFDSV Digital signature verify callable service

CSFECO Encode callable service

CSFEDC Compatibility service for the CUSP or PCF CIPHER macro

CSFEMK Compatibility service for the CUSP or PCF EMK macro

CSFENC Encipher callable service

CSFENC1 Encipher (with ALET) callable service

CSFGKC Compatibility service for the CUSP or PCF GENKEY macro

CSFKEX Key export callable service

CSFKGN Key generate callable service

CSFKIM Key import callable service

CSFKPI Key part import callable service

CSFKRC Key record create callable service

CSFKRD Key record delete callable service

CSFKRR Key record read callable service

CSFKRW Key record write callable service

CSFKYT Key test callable service

CSFKYTX Key test extended callable service

CSFMDG MDC generate callable service

CSFMDG1 MDC generate (with ALET) callable service

CSFMGN MAC generate callable service

CSFMGN1 MAC generate (with ALET) callable service

CSFMVR MAC verify callable service

CSFMVR1 MAC verify (with ALET) callable service

CSFOWH One-way hash generate callable service

CSFOWH1 One-way hash generate (with ALET) callable service

CSFPMCI Pass phrase master key/CKDS initialization panel service

| **CSFPCI** PCI interface

| **CSFPCM** PCICC management panel service

CSFPGN PIN generate callable service

CSFPKG PKA key generate

CSFPKI PKA key import callable service

CSFPKRC PKDS Record Create

CSFPKRD PKDS Record Delete

CSFPKRR PKDS Record Read

CSFPKRW PKDS Record Write

CSFPKSC PKSC interface

CSFPKD PKA decrypt callable service

CSFPKE PKA encrypt callable service

CSFPTR PIN translate callable service

CSFPVR PIN verify callable service

CSFREFR Refresh CKDS panel service

CSFPEXX Prohibit export extended callable service

CSFRENC Reencipher CKDS panel service

CSFRKD Retained key delete callable service

CSFRKL Retained key list callable service

CSFRNG Random number generate callable service

CSFRTC Compatibility service for the CUSP or PCF RETKEY macro

CSFSBC SET Block Compose

CSFSBD SET Block Decompose

CSFSKI Secure key import callable service

CSFSKM Multiple Secure Key Import

CSFSMK Set master key panel service

CSFSYG Symmetric key generate callable service

CSFSYI Symmetric key import callable service

CSFSYX Symmetric key export callable service

CSFTCK Transform CDMF key callable service

CSFUDK User derived key callable service

Notes:

a. As with any RACF general resource profile, if you want to change the profile later, use the RALTER command. To change the access list, use the PERMIT command as described in the next step.

b. If you have already started ICSF, you need to refresh the in-storage profiles. See Step 3 on page 45.

c. You can specify other operands, such as auditing (AUDIT operand), on the RDEFINE or RALTER commands. The NOTIFY operand is ignored when specified for profiles in the CSFSERV class.

d. If the RACF security administrator has activated generic profile checking for the CSFSERV class, you can create generic profiles using the generic characters * and %. This is the same as with any RACF general resource class. You *cannot* use RACF variables (generic profiles that are defined using an &) for the CSFSERV class.

Example

If generic profile checking is in effect, the following profiles enable you to specify which users and jobs can use the ciphertext translate callable services. No other services can be used by any job on the system. The user ID specified on the NOTIFY keyword enables you to determine who is using any other protected ICSF services.

```
RDEFINE  CSFSERV  CSFCTT   UACC(NONE)

RDEFINE  CSFSERV  CSFCTT1  UACC(NONE)

RDEFINE  CSFSERV  *        UACC(NONE)
         NOTIFY(userid)
```

2. Give appropriate users (preferably groups) access to the profiles:

```
PERMIT  profile-name  CLASS(CSFSERV)
        ID(groupid)  ACCESS(READ)
```

3. When the profiles are ready to be used, ask the RACF security administrator to activate the CSFKEYS class and refresh the in-storage RACF profiles:

```
SETROPTS  CLASSACT(CSFSERV)

SETROPTS RACLIST(CSFSERV) REFRESH
```

Chapter 4. Using the Pass Phrase Initialization Utility

The pass phrase initialization utility allows the casual user of ICSF to install the necessary master keys on both the Cryptographic Coprocessor Features and the PCI Cryptographic Coprocessors, and initialize the CKDS with a minimal effort. This chapter describes how to use this utility to get up and running quickly.

Performing Pass Phrase Initialization

With OS/390 ICSF on the S/390 G3 Enterprise Server, or higher, or S/390 Multiprise, you can install the DES and PKA master keys and initialize the CKDS on the S/390 Cryptographic Coprocessor Features by using the pass phrase initialization utility. You can also use this utility to install both the SYM-MK and ASYM-MK on any PCI Cryptographic Coprocessors on S/390 G5 Enterprise Servers, or above. The pass phrase is case sensitive and should be chosen according to the following rules:

- It can contain a minimum of 16 and a maximum of 64 characters.
- It can include any characters in the EBCDIC character set.
- It can contain imbedded blanks, but leading and trailing blanks are truncated.

The pass phrase initialization utility can be used to initialize the system and to initialize PCI Cryptographic Coprocessors that are brought online after system initialization. To use this utility special secure mode must be enabled, and all master key registers must be empty. You cannot use this utility to change master keys. To change master keys you need to use either the clear master key entry panels or the TKE workstation.

Since the same pass phrase will always produce the same master key values, you should secure the pass phrase in a safe place.

Before Running the Pass Phrase Initialization Utility

Before you run the pass phrase initialization utility for the first time, you must initialize ICSF by following these steps:

1. Install the ICSF program product according to the instructions in the *OS/390 Planning for Installation* and the *ICSF Program Directory*.
2. Create an empty CKDS.
3. Create an empty PKDS.
4. Create an installation options data set.
5. Create an ICSF startup procedure.
6. Start ICSF.
7. Access the ICSF panels.

These steps are described in the *OS/390 ICSF System Programmer's Guide*

Running the Pass Phrase Initialization Utility

After you start ICSF, you can use the ICSF panels to run the pass phrase initialization utility. When you access the ICSF panels, the primary menu panel appears. See Figure 14.

```
CSF@PRIM ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 8

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 14. Selecting the Pass Phrase Initialization Option on the ICSF Primary Menu Panel

1. Select option 8, PPINIT, and press ENTER to begin the pass phrase initialization utility.

   The Pass Phrase MK/CKDS Initialization panel appears. See Figure 15.

```
CSFPMC00 ------- OS/390 ICSF - Pass Phrase MK/CKDS Initialization ---
Command ===>
Enter your pass phrase and the name of the CKDS:

Pass Phrase (16 to 64 characters)
===>

CKDS
===>

Initialize the CKDS? (Y/N) ===>
Signature MK = Key Management MK? (Y/N) ===>




Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 15. ICSF Pass Phrase MK/CKDS Initialization Panel

2. Type the pass phrase and the data set name in the spaces that are provided. Refer to the example in Figure 16 on page 49.

The CKDS name must be a valid MVS data set.

Note: If you are reentering master keys after they have been cleared, use the same pass phrase as when you originally entered the keys. You should have saved the pass phrase in a secure place after you entered the master keys previously.

3. Answer the "Initialize the CKDS?" question by typing your response in the space following the question.
   a. If the CKDS has not been initialized, type Y.

      If you select Y, the CKDS name must refer to a valid, uninitialized CKDS.

   b. If this is an existing CKDS, type N.

      If you select N, the CKDS must have already been initialized with the pass phrase initialization utility and the identical pass phrase.

      ICSF checks and refreshes the existing CKDS.
4. Answer the "Signature MK = Key Management MK?" question by typing your response in the space following the question.
   a. If you have a new system with PCI Cryptographic Coprocessors installed, type Y.

      The signature master key and the key management master key will have the same value as the ASYM master key on the PCI Cryptographic Coprocessors. This increases the flexibility in routing services among the cryptographic coprocessors.

   b. If you have previously used pass phrase initialization and you have PKA key tokens that are encrypted under a key management master that cannot be recreated, type N.

```
CSFPMC00 --------- OS/390 ICSF - Pass Phrase MK/CKDS Initialization ----------------
Enter your pass phrase and CKDS data set name:

Pass Phrase (16 to 64 characters)
===> winnie the pooh and tigger too

CKDS
===> CRYPTO.CKDS.JAN1996

Initialize the CKDS? (Y/N) ===> Y
Signature MK = Key Management MK? (Y/N) ===> Y
```

Figure 16. Entering Options on the Pass Phrase MK/CKDS Initialization Panel

5. Press ENTER to run the utility.

   This utility uses the pass phrase, a series of constants, and the MD5 hash algorithm to:

   - Calculate the DES master key and load the new master key registers on the Cryptographic Coprocessor Features with the value.
   - Use the value of the DES master key as the value of the SYM-MK key and load the new master key registers on the PCI Cryptographic Coprocessors with the value.
   - Calculate the PKA master keys and set the PKA signature master key register and the PKA key management master key register with these

values. If you specified "Y" for the question about making the signature master key equal to the key management master key, then the value calculated for the key management master key will be used for both PKA master keys.

- Use the value of the PKA signature master key as the value of the ASYM-MK and set the new asymmetric-keys master key registers on the PCI Cryptographic Coprocessors with the value.
- Set the master key register.
- Initialize the CKDS or refresh an existing CKDS.

For details of these calculations, refer to “Pass Phrase Initialization Master Key Calculations” on page 328.

Messages on the bottom half of the panel display the progress of the utility.

6. When the utility has completed successfully, press END to return to the primary menu.

Adding PCICC after CCF Initialization

The pass phrase initialization utility can be used to initialize PCI Cryptographic Coprocessors after system initialization. The procedure is:

- Disable PKA callable services
- Reset NMK, SMK and KMMK registers on the CCF

  Note: The NMK may not need to be reset. You only need to reset the NMK if an OMK exists or if you loaded a NMK through Clear Master Key Entry or the TKE workstation.
- Run Pass Phrase Initialization Utility

The step-by-step procedure is:

1. Access the user control functions by choosing option 7, USERCNTL, on the Primary Menu panel, as shown in Figure 17.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 17. Selecting the Utility Option on the ICSF Primary Menu Panel

The User Control Function panel appears. See Figure 18 on page 51.

```
CSFUFN00 ------------- OS/390 ICSF – User Control Functions
OPTION ===>

Enter the number of the desired option.

  Dynamic CKDS Access
  1  Allow
  2  Disallow

  PKA Callable Services
  3  Enable
  4  Disable

  PKDS Read Access
  5  Allow
  6  Disallow

  PKDS Write, Create, and Delete Access
  7  Allow
  8  Disallow
```

Figure 18. Enabling and Disabling the PKA Callable Services

2. Enter the option and press ENTER. To disable the PKA callable services, select option 4, DISABLE.
3. Press PF3 on the USERCNTL panel and the primary menu panel once again appears.
4. This time select option 1, MASTER KEY, and press enter.
5. The first Master Key Management panel, as shown in Figure 19 appears. Select option 1, ENTER, and press enter.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 19. Selecting the Enter Option on the Master Key Management Panel

6. Another Master Key Management panel appears, (Figure 20 on page 52). Enter 1, Cryptographic Coprocessor Feature Clear Master Key Entry and press ENTER.

```
CSFMKM20------------- OS/390 ICSF - Master Key Management -----------------
 OPTION ===> 1


 Enter the number of the desired selection.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 20. Selecting the CCF Clear Master Key Entry Option on the Master Key Management Panel

7. Select the coprocessor for master key entry by typing the coprocessor number on the OPTION line and pressing ENTER.

   Note: If you have only one coprocessor installed, or if there is only one coprocessor defined to this LP, this panel will only show one coprocessor.

```
CSFMKP11 -------------------- OS/390 ICSF - Coprocessor Selection---------
OPTION ===> 0

                                                          CRYPTO DOMAIN: 0

Enter the number of the coprocessor to be used for key part input.

 REGISTER STATUS              0. COPROCESSOR C0       1. COPROCESSOR C1

                                                                MORE:     +
  Crypto Module ID           : E589C39694407A60     : C39997A396F1407A
                             : 5D40C39997A396F0     : 605D40E589C39694
  Crypto CPs installed       : 1                    : 3
  Crypto CPs active          : 1                    : 3

  Key Part register          : DISABLED AND EMPTY   : DISABLED AND EMPTY
  New Master Key register    : EMPTY                : EMPTY
  NMK verification pattern   :                      :
  Old Master Key register    : EMPTY                : EMPTY
  OMK verification pattern   :
  Old/New Master Key register: 3DA6449DC02286E99A   :  66E449A33052DF4
      hash pattern           : F87430D844DDA754CD   :  4452DAD849258BB

Press ENTER to select coprocessor and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 21. Coprocessor Selection Panel

8. The Clear Master Key Entry panel appears. See Figure 22 on page 53.

```
 CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key : C0
               New master key register status          : EMPTY
               PKA Key Management Master Key register  : FULL
               PKA Signature Master Key register       : FULL

  Specify information below
    Key Type  KMMK             (NMK, KMMK, SMK)

    Part      RESET           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000   (KMMK, SMK only)


  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 22. The Clear Master Key Entry Panel to Reset Registers

You need to RESET to clear the contents of the registers before you can set a new key value.

9. When you select RESET, the Restart Key Entry Process panel is displayed. See Figure 23.

   This panel confirms your request to restart the key entry process. Press ENTER.

```
 CSFDKE40 -------------- OS/390 ICSF - Restart Key Entry Process -------------


 ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


   Restarting the process will clear the KMMK   key register.


  WARNING:  Resetting the KMMK or SMK will invalidate any private
internal key tokens in the PKDS


Press ENTER to confirm restart request
Press END   to  cancel restart request
```

Figure 23. Confirm Restart Request Panel

10. You must also reset the SMK and NMK.

    Note: You need to reset the NMK if an OMK exists or if you loaded a NMK through Clear Master Key Entry or the TKE workstation.

11. If you have two cryptographic coprocessors, you must repeat the process for the second cryptographic coprocessor. Press PF3 and you should be at Figure 19 on page 51.

12. Once the CCFs have been cleared, run the Pass Phrase Initialization Utility.

    Access the primary menu panel.

```
CSF@PRIM ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 8

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 24. Selecting the Pass Phrase Initialization Option on the ICSF Primary Menu Panel

13. Select option 8, PPINIT, and press ENTER to begin the pass phrase initialization utility.

    The Pass Phrase MK/CKDS Initialization panel appears. See Figure 25.

```
CSFPMC00 ------- OS/390 ICSF - Pass Phrase MK/CKDS Initialization ---
Command ===>
Enter your pass phrase and the name of the CKDS:

Pass Phrase (16 to 64 characters)
===>

CKDS
===>

Initialize the CKDS? (Y/N) ===>
Signature MK = Key Management MK? (Y/N) ===>




Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 25. ICSF Pass Phrase MK/CKDS Initialization Panel

14. Type the pass phrase and the data set name in the spaces that are provided. Refer to the example in Figure 26 on page 55.

    The CKDS name must be a valid MVS data set.

    Note: You are reentering master keys after they have been cleared and must use the same pass phrase as when you originally entered the keys. You should have saved the pass phrase in a secure place after you entered the master keys previously.

15. Answer the "Initialize the CKDS?" question by typing your response in the space following the question. This is an existing CKDS, so you must type N.

    ICSF checks and refreshes the existing CKDS.

16. Answer the "Signature MK = Key Management MK?" question by typing your response in the space following the question.

    a. If you have a new system with PCI Cryptographic Coprocessors installed, type Y.

       The signature master key and the key management master key will have the same value as the ASYM master key on the PCI Cryptographic Coprocessors. This increases the flexibility in routing services among the cryptographic coprocessors.

    b. If you have previously used pass phrase initialization and you have PKA key tokens that are encrypted under a key management master that cannot be recreated, type N.

```
CSFPMC00 --------- OS/390 ICSF - Pass Phrase MK/CKDS Initialization ----------
Enter your pass phrase and CKDS data set name:

Pass Phrase (16 to 64 characters)
===> winnie the pooh and tigger too

CKDS
===> CRYPTO.CKDS.JAN1996

Initialize the CKDS? (Y/N) ===> N
Signature MK = Key Management MK? (Y/N) ===> Y
```

Figure 26. Entering Options on the Pass Phrase MK/CKDS Initialization Panel

17. Press ENTER to run the utility.

    For details of these calculations, refer to “Pass Phrase Initialization Master Key Calculations” on page 328.

    Messages on the bottom half of the panel display the progress of the utility.

18. When the utility has completed successfully, press END to return to the primary menu.

Chapter 5. Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise

You can have up to two Cryptographic Coprocessor Features on each S/390 G3 Enterprise Server, or higher or S/390 Multiprise. Each Cryptographic Coprocessor Feature is capable of performing cryptographic functions and holding the master keys within a secure boundary. This chapter describes how to use the clear master key entry panels to enter master keys into a Cryptographic Coprocessor Feature on a S/390 server with no PCI Cryptographic Coprocessor installed.

For information on using the clear master key entry panels to enter master keys into both a Cryptographic Coprocessor Feature and a PCI Cryptographic Coprocessor, refer to Chapter 6, “Managing Master Keys on the S/390 Enterprise Server with PCI Cryptographic Coprocessors” on page 89.

Entering Clear Master Key Parts

You can use the Clear Master Key Entry panels to enter clear master key parts. The way you obtain master key parts depends on the security guidelines in your enterprise. You may receive master key parts from a key distribution center or you may generate your own key parts using the ICSF random number utility.

When you enter the PKA master keys the first time, the PKA callable services are initially disabled. Once you have entered the PKA master keys, you must enable the PKA callable services for these services to work. Before you change the PKA master keys, you need to disable the PKA callable services. To enable and disable the PKA callable services refer to “Enabling and Disabling PKA Services.”

To enter master key parts that you do not generate using the random number utility, continue with “Entering the First Master Key Part” on page 64.

To begin master key entry by generating random numbers for the key parts, continue with “Generating Master Key Data for Clear Master Key Entry” on page 58.

Enabling and Disabling PKA Services

When you enter or change the PKA master keys you must first disable the PKA services. To enable or disable PKA services:

1. Access the user control functions by choosing option 7, USERCNTL, on the Primary Menu panel, as shown in Figure 27 on page 58.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 27. Selecting the Utility Option on the ICSF Primary Menu Panel

The User Control Function panel appears. See Figure 28.

```
CSFUFN00 ------------- OS/390 ICSF - User Control Functions
OPTION ===>

Enter the number of the desired option.

  Dynamic CKDS Access
  1  Allow
  2  Disallow

  PKA Callable Services
  3  Enable
  4  Disable

  PKDS Read Access
  5  Allow
  6  Disallow

  PKDS Write, Create, and Delete Access
  7  Allow
  8  Disallow
```

Figure 28. Enabling and Disabling the PKA Callable Services

2. Enter the option and press ENTER.
   - To enable the PKA callable services, select option 3, ENABLE.

     Note: If using a PKDS, you must also enable PKDSRead and PKDSWrite.
   - To disable the PKA callable services, select option 4, DISABLE.

Generating Master Key Data for Clear Master Key Entry

If you intend to use the clear key entry panels to enter master keys, you need to generate and record the following values before you begin:

- Key parts
- Checksums
- Verification patterns (optional)
- Hash patterns (optional)

Note: If you are reentering master keys after they have been cleared, use the same master key part values as when you originally entered the keys. You should have saved the key part values in a secure place after you entered the master keys previously.

A DES master key is 16 bytes long. ICSF defines a DES master key by exclusive ORing two or more key parts. Each of the master key parts is also 16 bytes long. To enter a DES master key, you must enter a first key part and a final key part. If you choose to, you can also enter one or more intermediate key parts after entering the first key part and before entering the final key part.

Note: The combined DES master key is forced to have odd parity, but the parity of the individual key parts can be odd, even or mixed. We refer to even or mixed parity keys as non-odd parity keys.

A PKA master key is 24 bytes long. ICSF defines a PKA master key by exclusive ORing two or more key parts. Each of the PKA master key parts is also 24 bytes long.

If you are using ICSF to generate random numbers, generate a random number for each key part that you need to enter to create the master key.

Note: It is recommended that you enter the same key value for the SMK and KMMK. This will allow ICSF flexibility in workload balancing.

A 16-byte key part consists of 32 hexadecimal digits. A 24-byte key part consists of 48 hexadecimal digits. To make this process easier, each part is broken into segments of 16 digits each.

When you are manually entering the master key parts, you also enter a checksum that verifies whether you entered the key part correctly. A checksum is a two-digit result of putting a key part value through a series of calculations. The Cryptographic Coprocessor Feature calculates the checksum with the key part you enter and compares the one it calculated with the one you entered. The checksum verifies that you did not transpose any digits when entering the key part. If the checksums are equal, you have successfully entered the key.

After you enter a key part and its checksum for a DES master key, the Cryptographic Coprocessor Feature calculates an eight-byte verification pattern. After you enter a key part and its checksum for a PKA master key, the Cryptographic Coprocessor Feature calculates an eight-byte hash pattern.

Before the verification and hash patterns can be calculated, the DES master key must have been set.

The ICSF Clear Master Key Entry panel displays the verification pattern or hash pattern. Check the displayed verification pattern against the optional verification pattern you may have generated at the time you generated the DES master key part and the checksum. Check the displayed hash pattern against the optional hash pattern that you may have generated at the same time you generated the PKA master key part and the checksum. The verification pattern or hash pattern checks whether you entered the key part correctly, and whether you entered the correct key type. ICSF displays a verification pattern for each DES master key part. It also displays a verification pattern for the DES master key after you enter all the key parts. If the verification patterns are the same, you have entered the key part correctly. Likewise, in addition to displaying a hash pattern for each PKA master key part, ICSF also displays a hash pattern for the PKA master key after you enter all the key parts. If the hash patterns are the same, you have entered the key part correctly.

Note: Keys stored in the CKDS are enciphered under the DES master key. The master key verification pattern is stored in the CKDS header record. Checking the verification pattern is optional; it is not required for key entry.

To generate the value for a key part, you can use one of the following methods:

- Choose a random number yourself.
- Access the ICSF utility panels to generate a random number.
- Call the random number generate callable service. For more information, see the *OS/390 ICSF Application Programmer's Guide*.

  Note: ICSF must be initialized with a DES master key before you can use the random number generate callable service or the Random Number Generator panel.

The following topics describe using the ICSF utilities to generate key parts, checksums, verification patterns, and hash patterns.

Generating Key Parts Using ICSF Utilities

1. Access ICSF utilities by choosing option 5, UTILITY, on the Primary Menu panel, as shown in Figure 29.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 29. Selecting the Utility Option on the ICSF Primary Menu Panel

The Utilities panel appears. See Figure 30. You use the RANDOM and CHECKSUM options to generate random numbers, checksums, and verification patterns for master key management.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities --------------------------
OPTION ===> 3


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
```

Figure 30. ICSF Utilities Panel

2. Choose option 3, RANDOM, to access the Random Number Generator panel, shown in Figure 31 on page 61.

```
CSFRNG00 ---------------- OS/390 ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 0000000000000000  Random Number 1
  Random Number2    : 0000000000000000  Random Number 2
  Random Number3    : 0000000000000000  Random Number 3
```

Figure 31. ICSF Random Number Generator Panel

3. To select the parity of the random numbers, enter ODD, EVEN, or RANDOM next to Parity Option and press ENTER.

   The DES master key is forced to have odd parity, regardless of the parity option you select for each key part.

   A random 16-digit number appears in each of the Random Number fields. You can use each of these random numbers for a segment of a key part.

   Note: The third random number is only for PKA master keys. It is not used for DES master keys or operational keys.

```
CSFRNG00 ---------------- OS/390 ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 51ED9CFA90716CFB  Random Number 1
  Random Number2    : 58403BFA02BD13E8  Random Number 2
  Random Number3    : 9B28AEFA8C47760F  Random Number 3
```

Figure 32. ICSF Random Number Generator Panel with Generated Numbers

4. *Record the random numbers* so you can store them in a safe place. If you ever need to reenter a master key that has been cleared for any reason, you will need the key part values.

   After you end the utility panels and access the Clear Master Key Part Entry panel, the key parts you generated are transferred automatically to the Clear Master Key Part Entry panels. For this reason, you will not need to enter the key parts on the Clear Master Key Part Entry panels.

5. Press END to return to the Utilities panel.
6. Continue with Generating a Checksum, Verification Pattern, or Hash Pattern for a Key Part.

Generating a Checksum, Verification Pattern, or Hash Pattern for a Key Part

You can use the ICSF utilities panel to generate a checksum and either an optional verification pattern or an optional hash pattern for a key part. You can use this panel to generate a checksum for a key part even if ICSF has not been initialized. The random number generator and the verification pattern, however, do not work until ICSF has been initialized with a valid master key.

Note: The use of these utility panels to generate the key part, the checksum, and the verification pattern exposes the key part in storage for the duration of the dialogs. For this reason, you can choose to calculate both the checksum, the verification pattern or the hash pattern values manually or by using a PC program. See “Checksum Algorithm” on page 325 for a description of the checksum algorithm. See “Algorithm for Calculating a Verification Pattern” on page 327 for a description of the algorithm for the verification pattern. See “The MDC–4 Algorithm for Generating Hash Patterns” on page 328 for a description of the MDC-4 algorithm that is used to calculate a hash pattern for a key part. The use of the verification pattern or hash pattern is optional.

Follow these steps to generate a checksum and the optional verification pattern or hash pattern for a key part.

1. Select option 4, CHECKSUM, on the ICSF Utilities panel as shown in Figure 33.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities -------------------------
OPTION ===> 4


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
```

Figure 33. Selecting the Checksum Option on the ICSF Utilities Panel

The Checksum and Verification Pattern panel appears. See Figure 34.

```
CSFMKV00 ------------ OS/390 ICSF - Checksum and Verification Pattern -----
COMMAND ===>


Enter data below:

  Key Type        ===>                   (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 9B28AEFA8C47760F  Input last key part (PKA keys only)

  Checksum           : 00                Check digit for key part
  Key Part VP        : 0000000000000000  Verification Pattern

  Key Part HP        : 0000000000000000  Hash Pattern
                     : 0000000000000000
```

Figure 34. ICSF Checksum and Verification Pattern Panel

If you accessed the Random Number Generator panel before this panel, the random numbers that are generated appear automatically in the Key Part fields. You can skip the next step.

2. If you did not use the ICSF panels to generate random numbers, enter the numbers for which you want to create checksum, verification pattern, or hash patterns into these fields.
3. In the Key Type field, specify either:
   - MASTER to generate a checksum and verification pattern for a DES master key part.
   - PKAMSTR to generate a checksum and hash pattern for a PKA master key part.

   If you leave the Key Type field blank and press ENTER, the Key Type Selection panel appears. See Figure 35.

```
CSFMKV10 ------------- OS/390 ICSF - Key Type Selection Panel ---- ROW 1 to 9 OF 9
COMMAND ===>                                                  SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   EXPORTER   Export key-encrypting key
   IMP-PKA    Limited authority importer
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
s  MASTER     DES master key
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
   PKAMSTR    PKA master key
****************************** BOTTOM OF DATA *******************************
```

Figure 35. Key Type Selection Panel Displayed During Hardware Key Entry

4. Type s to the left of the MASTER key type, and press ENTER to return to the Checksum and Verification Pattern panel as shown in Figure 36.

   In this example, we have selected the DES master key.

```
CSFMKV00 ------ OS/390 ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

  Key Type        ===> MASTER            (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 9B28AEFA8C47760F  Input last key part (PKA keys only)

  Checksum           : 00                Check digit for key part
  Key Part VP        : 0000000000000000  Verification Pattern

  Key Part HP        : 0000000000000000  Hash Pattern
                     : 0000000000000000
```

Figure 36. ICSF Checksum and Verification Pattern Panel

5. On the Checksum and Verification Pattern panel, press ENTER.

   ICSF calculates the checksum, verification pattern, and hash pattern for the key part segments and displays them on the panel as shown in Figure 37 on page 64. Since a DES master key was selected for this example, the key part last segment was not used in the calculations. The key part last field is zeroed

out on the panel. For a PKA master key, ICSF uses all three key part segments to calculate the checksum, verification pattern, and hash pattern.

```
CSFMKV00 ------ OS/390 ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

  Key Type        ===> MASTER            (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 0000000000000000  Input last key part (PKA keys only)

  Checksum           : 40                Check digit for key part
  Key Part VP        : 0CCE190A635A6C89  Verification Pattern
  Key Part HP        : EA58E51179754FB7  Hash Pattern
                     : C102957465CE479E
```

Figure 37. Checksum, Verification Pattern, and Hash Pattern Calculated for a DES Master Key Part

6. *Record the checksum, verification pattern, and hash pattern.*

   Save these values in a secure place along with the key part values in case of a tamper. If the Cryptographic Coprocessor Feature detects tampering, it clears the master key, and you have to reenter the same master key again.

7. Press END to return to the Utilities panel.
8. Press END again to return to the ICSF Primary menu.

Continue with the appropriate section for steps to enter the master key part you have just generated.

- If you have generated the first master key part, continue with “Entering the First Master Key Part.”
- If you have generated an intermediate master key part, continue with “Entering Intermediate Key Parts” on page 68.
- If you have generated a final master key part, continue with “Entering the Final Key Part” on page 70.

Entering the First Master Key Part

Use the Clear Master Key Entry panels to enter each key part. If you use the random number generator utility to generate key parts, enter each key part directly after you generate the key part data and before generating another key part. If you follow this sequence, the key parts you generate are transferred directly to the Clear Master Key Entry panel, eliminating the need to type in the values. This avoids errors that can result when typing in key part values manually.

To enter master key parts:

1. Select option 1, MASTER KEY, on the ICSF Primary menu, as shown in Figure 38 on page 65, and press ENTER.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 38. ICSF Selecting the Master Key Option on the Primary Menu Panel

The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel, as shown in Figure 39.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 39. Selecting the Enter Option on the Master Key Management Panel

Another Master Key Management panel appears. See Figure 40.

3. Enter 1, CLEAR MASTER KEY ENTRY and press ENTER.

   Note: To use the trusted key entry workstation, refer to the *OS/390 ICSF TKE Workstation User's Guide* and *OS/390 ICSF TKE Workstation User's Guide 2000*.

```
CSFMKM10------------- OS/390 ICSF - Master Key Management -----------------
 OPTION ===> 1


 Enter the number of the desired selection.

   1  CLEAR MASTER KEY ENTRY - Enter the DES and PKA master keys via panels.

   2  TRUSTED KEY ENTRY - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 40. Selecting the Clear Master Key Entry Option on the Master Key Management Panel

The Coprocessor Selection panel appears. It may be similar to the one in Figure 41 on page 66. For a description of the coprocessor status parameters

that are defined on this panel, refer to “Displaying Hardware Status” on page 285.

4. Select the coprocessor for master key entry by typing the coprocessor number on the OPTION line and pressing ENTER.

   Note: If you have only one coprocessor installed, or if there is only one coprocessor defined to this LP, this panel will only show one coprocessor.

```
 CSFMKP11 -------------------- OS/390 ICSF - Coprocessor Selection---------
 OPTION ===> 0

                                                              CRYPTO DOMAIN: 0

  Enter the number of the coprocessor to be used for key entry.
 REGISTER STATUS             0. COPROCESSOR C0       1. COPROCESSOR C1
                                                          MORE:     +
Crypto Module ID              : E589C39694407A60     : C39997A396F1407A
                              : 5D40C39997A396F0     : 605D40E589C39694
   Crypto CPs installed       : 1                    : 3
   Crypto CPs active          : 1                    : 3
   Key Part register          : DISABLED AND EMPTY   : DISABLED AND EMPTY
   New Master Key register    : EMPTY                : EMPTY
   NMK verification pattern   :                      :
   Old Master Key register    : EMPTY                : EMPTY
   OMK verification pattern   :
   Old/New Master Key register: 3DA6449DC02286E99A   :  66E449A33052DF4
       hash pattern           : F87430D844DDA754CD   :  4452DAD849258BB

 Press ENTER to select coprocessor and proceed to new master key part entry.
 Press END   to exit to the previous menu.
```

Figure 41. Coprocessor Selection Panel

5. After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. See Figure 42.

```
 CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key : C0
               New master key register status          : EMPTY
               PKA Key Management Master Key register  : EMPTY
               PKA Signature Master Key register       : EMPTY

  Specify information below
    Key Type  ___              (NMK, KMMK, SMK)

    Part      ______           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  40

    Key Value ===> 51ED9CFA90716CFB
              ===> 58403BFA02BD13E8
              ===> 0000000000000000   (KMMK, SMK only)



  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 42. The Clear Master Key Entry Panel with Key Value Data Transferred from the Random Number Generator

6. Enter the master key type in the Key Type field.

   In this example we show entering a new master key (NMK). This is the DES master key.

7. Enter FIRST in the Part field.

   If you have just used the random number generator utility to generate a key part, ICSF transfer the checksum and the key value directly to this screen. You do not need to enter these values so you can skip the next step.

8. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.

9. When all the fields are complete, press ENTER.

   If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 43. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

10. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry --- KEY PART LOADED
COMMAND ===>
                Coprocessor selected for new master key   : C0
                New master key register status            : PART FULL
                PKA Key Management Master Key register    : EMPTY
                PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  NMK_             (NMK, KMMK, SMK)

   Part      FIRST_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)

 Entered key part VP:  0CCE190A635A6C89  HP: EA58E51179754FB7  C102957465CE479E

                    (Record and secure these patterns)
 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 43. The Clear Master Key Entry Panel Following Key Part Entry from the Random Number Generator

If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:

a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the first key part successfully, continue with:

- "Generating Key Parts Using ICSF Utilities" on page 60 if you are using the ICSF utilities to generate random numbers for key values.
- "Entering Intermediate Key Parts" if you are entering key parts manually.

Entering Intermediate Key Parts

If you want to enter more than two key parts, you must enter one or more intermediate key parts. Enter intermediate key parts after you enter the first key part and before you enter the final one.

To enter intermediate master key parts:

1. Select option 1, MASTER KEY, on the ICSF Primary menu and press ENTER.

   The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel.

   The Coprocessor Selection panel appears.

3. Select the coprocessor for master key entry by typing the coprocessor number on the OPTION line and pressing ENTER.

   After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. See Figure 44. If you used the random number generator utility to generate key part data just before accessing the Clear Master Key Entry panel, the key part values and checksum are transferred directly to this panel. This eliminates the need to retype these values.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key   : C0
               New master key register status            : PART FULL
               PKA Key Management Master Key register    : EMPTY
               PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  ____             (NMK, KMMK, SMK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 44. The Clear Master Key Entry Panel with Intermediate Key Values

4. Enter the master key type in the Key Type field.

   In this example we show entering the new master key (NMK).

5. Enter MIDDLE in the Part field.

If you have just used the random number generator utility to generate a key part, the checksum and the key value are transferred directly to this screen. You do not need to enter these values, so you can skip the next step.

6. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.
7. When all the fields are complete, press ENTER.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key   : C0
               New master key register status            : PART FULL
               PKA Key Management Master Key register    : EMPTY
               PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  NMK_             (NMK, KMMK, SMK)

   Part      MIDDLE           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (KMMK, SMK only)

 Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679

                   (Record and secure these patterns)
```

Figure 45. The Clear Master Key Entry Panel with Intermediate Key Values

If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The new master key register status continues to indicate `PART FULL`. The verification pattern and hash pattern that the Cryptographic Coprocessor Feature calculated for the key part appear near the bottom of the panel. See Figure 45.

8. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

   If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:

   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the middle key part successfully, continue with:

- "Generating Key Parts Using ICSF Utilities" on page 60 if you are using the ICSF utilities to generate random numbers for key values.

- “Entering the Final Key Part” on page 70 if you are entering key parts manually.

Entering the Final Key Part

After you enter the first key part, and any intermediate key parts, you then enter the final master key part as explained here:

1. Select option 1, MASTER KEY, on the ICSF Primary menu and press ENTER.

   The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel.

   The Coprocessor Selection panel appears.

3. Select the coprocessor for master key entry by typing the coprocessor number on the OPTION line and pressing ENTER.

   After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. If you used the random number generator utility to generate key part values just before accessing the Clear Master Key Entry panel, the key part values are transferred directly to this panel. This eliminates the need to retype these values.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                Coprocessor selected for new master key   : C0
                New master key register status            : PART FULL
                PKA Key Management Master Key register    : EMPTY
                PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  ___               (NMK, KMMK, SMK)

   Part      ______            (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 99

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 0000000000000000   (KMMK, SMK only)



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 46. The Clear Master Key Entry Panel with Final Key Values

4. Enter the master key type in the Key Type field.

   In this example we show entering the new master key (NMK).

5. Enter FINAL in the Part field.

   If you have just used the random number generator utility to generate a key part, the checksum and the key value are transferred directly to this screen. You do not need to enter these values, so you can skip the next step.

6. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.

7. When all the fields are complete, press ENTER.

If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The new master key register status changes to `FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

If the checksums do not match, the message `INVALID CHECKSUM` appears. If this occurs, follow this sequence to resolve the problem:

a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

8. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

   When you have entered the final key part successfully, it is combined with the first key part and any intermediate key parts in the new master key register.

   The new master key register status is now FULL, and the panel displays two verification patterns and two hash patterns. It gives you verification patterns and hash patterns for both the final key part and the new master key, since it is now complete.

9. Check that the key part verification pattern or hash pattern you may have previously calculated matches the verification pattern or hash pattern that is shown on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see "Restarting the Key Entry Process" on page 72.

10. *Record the verification pattern and hash pattern* for the new master key, because you may want to verify it at another time.

    Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the DES master key into the CKDS header record.

When you have entered the DES master key correctly, it is in the new master key register and is not active on the system yet.

Note: If you have two crypto units installed, you need to repeat the process for entering the master key on the second crypto.

After you enter the DES master key, you should do *one* of the following:

- If you are defining the master key for the first time, initialize the CKDS with the DES master key. For a description of the process of initializing a DES master key on your system, see "Initializing the CKDS at First-Time Startup" on page 74.
- If you are defining a DES master key after it was cleared, set the DES master key to make it active. For a description of the process of recovering from tampering, see "Reentering Master Keys After They have been Cleared" on page 77.

- If you are changing a DES master key, reencipher the CKDS under the new DES master key and make it active. For a description of the process of changing a DES master key, see “Changing Master Keys” on page 79.

When you have entered the PKA master keys correctly, the PKA master key registers are active when the final key part is loaded. To use PKA callable services, however, you have to enable this service option on the User Control Function panel. For information on enabling PKA callable services, see “Enabling and Disabling PKA Services” on page 57.

Restarting the Key Entry Process

If you realize that you made an error when entering a key part, you can restart the process of entering the new master key. For example, if the verification pattern or the hash pattern that the Cryptographic Coprocessor Feature calculates does not match the one that you calculated, you may want to restart the process. Restarting the key entry process clears the new master key register, which erases all the new master key parts you entered previously.

Note: When you enter the first key part, your old master key is lost, even if you restart the process.

To restart the key entry process, follow the steps below:

1. On the Clear Master Key Entry panel, enter the master key type in the Key Type field.

   In this example, we are entering a new DES master key (NMK).

2. Enter RESET in the Part field.

3. Press ENTER.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>

                Coprocessor selected for new master key   : C0
                New master key register status            : PART FULL
                PKA Key Management Master Key register    : EMPTY
                PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  NMK              (NMK, KMMK, SMK)

   Part      RESET_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 47. Selecting Reset on the Clear Master Key Entry Panel

The Restart Key Entry Process panel appears. See Figure 48 on page 73.

```
CSFEKM30 -------------- OS/390 ICSF - Restart Key Entry Process -------------
COMMAND ===>

ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the new master key register.




Press ENTER to confirm restart request
Press END   to cancel restart request
```

Figure 48. Confirm Restart Request Panel

This panel confirms your request to restart the key entry process.

Note: If you are restarting the key entry process for one of the PKA master keys, the panel message will differ. ICSF substitutes either “KMMK register” or “SMK register” for “the new master key register” phrase in the panel message.

4. If you want to restart the key entry process, press ENTER.

   The restart request automatically empties the master key register.

5. If you do not want to restart, press END.

   After you make a choice, you return to the Clear Master Key Entry panel. If you selected to continue with the restart process, the new master key register status field is reset to EMPTY, as shown in Figure 49. This indicates that the register has been cleared.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                Coprocessor selected for new master key  : C0
                New master key register status           : EMPTY
                PKA Key Management Master Key register   : EMPTY
                PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  ___              (NMK, KMMK, SMK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 49. The Clear Master Key Entry Panel Following Reset Request

6. Either begin the key entry process again or press END to return to the ICSF primary menu panel.

Initializing the CKDS at First-Time Startup

The first time you start ICSF, you must enter a DES master key, create a cryptographic key data set (CKDS), and initialize the CKDS. When you initialize the CKDS, ICSF creates a header record for the CKDS, installs the required system keys in the CKDS, and sets the DES master key. Keys stored in the CKDS are enciphered under the DES master key.

After you define the DES master key and initialize a CKDS, you can generate or enter any additional system keys you need to perform cryptographic functions.

There are four different types of system keys you can install in the CKDS:

- Required SYSTEM keys are automatically generated when you first initialize the CKDS. These include the MAC and MACVER keys that ICSF uses to generate and validate the MAC code in each CKDS record.
- NOCV-enablement keys are required for NOCV IMPORTERs and EXPORTERs. The NOCV-enablement system keys are used to twist on and twist off the CVs on external tokens during key import and key export. This allows ICSF to communicate with systems that do not use control vectors.
- ANSI system keys are required for almost all ANSI services to perform the notarization and offset that are required by ANSI X9.17.
- ESYS, or enhanced system keys, are used only in Symmetric Key Export service.

For information on system keys, see “Entering System Keys into the Cryptographic Key Data Set (CKDS)” on page 26.

You have to initialize a CKDS only the first time you start ICSF on a system. After you initialize a CKDS, you can copy the disk copy of the CKDS to create other CKDSs for use on the system. You can also use a CKDS on another ICSF system if the system has the same master key value. At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see “Refreshing the CKDS at Any Time” on page 76.

To define a master key and initialize a CKDS:

1. Enter a master key into the new master key register.

   For a description of how to use the Clear Master Key Entry panels to enter the master key, see “Entering the First Master Key Part” on page 64. For a description of how to use the TKE workstation to enter the master key, refer to the *OS/390 ICSF TKE Workstation User's Guide 2000*.

2. Initialize the CKDS.

   After you enter the master key, the master key is not active until you initialize the CKDS. This sets the new master key.

   a. Return to the Primary Menu panel by pressing END from the Clear Master Key Entry panel.

   b. Select Option 6, CKDS, on the Primary Menu panel as shown in Figure 50 on page 75.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 6

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
```

Figure 50. ICSF Selecting the CKDS Initialization Option on the Primary Menu Panel

The Initialize a CKDS panel appears. See Figure 51.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 51. ICSF Initialize a CKDS Panel

c. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

   The name you enter should be the same name that is specified in the CKDSN installation option in the installation options data set. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see the *OS/390 ICSF System Programmer's Guide*.

d. Choose option 1, Initialize an empty CKDS, and press ENTER.

   ICSF creates the header record in the disk copy of the CKDS. Next, ICSF sets the DES master key. ICSF then adds the required system keys to the CKDS and refreshes the CKDS. When ICSF completes all these steps, the message `INITIALIZATION COMPLETE` appears. If you did not enter a master key into the new master key register previously, the message `NMK REGISTER NOT FULL` appears and the initialization process ends. You must enter a master key into the new master key register before you can initialize the CKDS.

   Note: If any part of the option 1 fails, you must delete the CKDS and start over. If the failure occurs after the master key has been set and before the system keys have been created, you will need to reset the master keys.

e. If you want ICSF to create NOCV-enablement keys after the initialization process has been completed, select option 2, NOCVKEYS, and press ENTER.

   The creation of NOCV-enablement keys is optional. It allows you to use either the key generator utility program or the Key Token Build callable service to create NOCV keys. NOCV keys allow you to send and receive keys from systems that do not use control vectors. For a description of NOCV keys, see the description of the NOCV keyword for the key generator utility program in 223.

   Note: If you want to run the ICSF conversion program to convert a CUSP/PCF CKDS into ICSF format, the CKDS you start ICSF with must contain NOCV-enablement keys. For more information about the conversion program, see the *OS/390 ICSF System Programmer's Guide*.

f. To create ANSI system keys that are used for the ANSI X9.17 services, choose option 3, ANSI.

   The creation of ANSI system keys is optional. ANSI system keys are required if you intend to also create enhanced system keys.

   The message `ANSI KEYS ADDED` appears on the top right of the panel, if the process succeeds.

g. To create enhanced system keys, choose option 4, ESYS.

   The creation of enhanced system keys is optional. To create enhanced system keys, you must have previously installed the ANSI system keys in the CKDS.

   The message `ESYS KEYS ADDED` appears on the top right of the panel, if the process succeeds.

After you complete the entire process, a master key and CKDS exist on your system. You can now generate keys using the key generate callable service and key generator utility program, or convert CUSP/PCF keys to ICSF keys using the conversion program. You can also enter keys into the KSU by use of KGUP. ICSF services use the keys to perform the cryptographic functions you request.

Note: You enable special secure mode to initialize ICSF for the first time. After you perform the initialization process, you may choose to disable special secure mode.

Refreshing the CKDS at Any Time

After you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use KGUP to add and update any of the disk copies on your system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage CKDS. For information about using KGUP, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213. For information on using the dynamic CKDS callable services, refer to the *OS/390 ICSF Application Programmer's Guide*.

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS by following the steps below. You can refresh the CKDS at any time without disrupting cryptographic functions.

Note: Before you refresh a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

1. Enter option 6, CKDS, on the ICSF Primary Menu panel to access the Initialize a CKDS panel, which is shown in Figure 52.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>  5


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'PIN1.CKDS'
```

Figure 52. Selecting the Refresh Option on the ICSF Initialize a CKDS Panel

2. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.
3. Choose option 5, REFRESH, and press ENTER.

   ICSF places the disk copy of the specified CKDS into storage. During a REFRESH, ICSF does not load into storage any partial keys that may exist when you enter keys manually. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.

   After ICSF reads the CKDS into storage, it performs a MAC verification on each record in the CKDS. If a record fails the MAC verification, ICSF sends a message that gives the key label and type to the OS/390 system security console. You can then use either KGUP or the dynamic CKDS update services to delete the record from the CKDS. Any other attempts to access a record that has failed MAC verification results in a return code and reason code that indicate that the MAC is not valid.
4. Press END to return to the Primary Menu panel.

Note: You can use either a KGUP panel or a utility program, instead of the CKDS panel, to refresh the CKDS. For information about these other methods, see “Refreshing the In-Storage CKDS” on page 247.

Reentering Master Keys After They have been Cleared

In the following situations, the Cryptographic Coprocessor Feature clears the master key registers so that the master key values are not disclosed.

- If the Cryptographic Coprocessor Feature detects tampering
- If you issue a command from the TKE workstation to zeroize a domain
- If you issue a command from the Support Element to zeroize all domains

Although the values of the master keys are cleared, the keys in the CKDS are still enciphered under the cleared DES master key. The RSA and DSS private key are also each enciphered under one of the cleared PKA master keys. Therefore, to recover the keys in the CKDS, and the PKA private keys, you must reenter the same master keys and activate the DES master key. For security reasons, you may then want to change all the master keys.

PR/SM Considerations: If you are running in PR/SM logical partition (LPAR) mode, there are several situations (listed previously) that can cause loss of master keys and other data. In these cases, you must first ensure that key entry is enabled for each LP on the Change LPAR Crypto page on the support element Hardware Master Console. You must then reenter the master keys in each LP. If you zeroize a domain using the TKE workstation, however, the master keys are cleared only in that domain. Master keys in other domains are not affected and do not need to be reentered. For more information about reentering master keys in LPAR mode, see Appendix C, “PR/SM Considerations during Key Entry” on page 331.

After the Cryptographic Coprocessor Feature clears the master keys, reenter the same master keys by following these steps:

1. Check the status of the PKA callable services. If they are enabled, use the User Control Functions to disable them. See “Enabling and Disabling PKA Services” on page 57 for details.
2. Retrieve the key parts, checksums, verification patterns, and hash patterns you used when you entered the master keys originally.

   These values should be stored in a secure place as specified in your enterprises security process.
3. Access the Clear Master Key Entry panels and enter the master keys as described in “Entering the First Master Key Part” on page 64.

   After you enter the DES master key, the Master Key Management panel appears. See Figure 53.

   To activate the DES master key you just entered, you need to set it.
4. To set the DES master key, choose option 2 on the panel and press ENTER.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  2


Enter the number of the desired option above.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 53. Selecting the Set Host Master Key Option on the ICSF Master Key Management Panel

After you select option 2, ICSF checks that the states of the registers are correct. ICSF then transfers the DES master key from the new master key register to the master key register. This process sets the DES master key.

When ICSF attempts to set the DES master key, it displays a message on the top right of the Master Key Management panel. The message indicates either

that the master key was successfully set, or that an error prevented the completion of the set process.

Notes:

a. If your system is using both crypto modules provided by a Cryptographic Coprocessor Feature, ICSF sets the DES master key for each crypto module whose new DES master key enciphers the in-storage CKDS. You should reenter the DES master key into the new master key register for each of the crypto modules.

b. The operator console receives messages that state that the crypto module is offline and then online for each crypto module. These actions should not affect cryptographic operations. However, if a crypto module does not have either a current DES master key or a new DES master key that enciphers the current in-storage CKDS, the crypto module is left offline.

When you set the reentered DES master key, the DES master key that enciphers the existing CKDS now exists.

5. You can now change the DES master key, if you choose to, for security reasons. Continue with “Changing Master Keys.”

Changing Master Keys

For security reasons your installation should change the master keys periodically. In addition, if the master keys have been cleared, you may also want to change the master keys after you reenter the cleared master keys.

There are three main steps involved in changing the DES master key:

1. Enter the DES master key parts.
2. Reencipher the CKDS under the new DES master key.
3. Activate the new DES master key.

The step-by-step procedure for changing the DES master key, reenciphering the CKDS, and activating the new DES master key are presented in “Changing the Master Key Using the Master Key Panels” on page 81. This section provides some background on the contents of the master key registers during the key change process, and some compatibility mode considerations.

A DES master key and a CKDS that contains keys that are enciphered under that DES master key already exist. Before you replace this existing DES master key with the new DES master key, you must reencipher the CKDS under the new DES master key.

Note: Before you reencipher a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

If you changed the DES master key before, the previous DES master key that was stored in the auxiliary (or new/old) master key register. The currently active DES master key exists in the master key register. When you enter the key parts of a new DES master key, they displace the previous DES master key in the auxiliary master key register. Therefore, the previous DES master key is lost.

To make the new DES master key the current active DES master key, you have ICSF swap the contents of the master key register and the auxiliary master key

register. In this way, the new DES master key you have just entered becomes the current DES master key, and the previous DES master key is stored in the auxiliary master key register.

Before the new DES master key is placed into the master key register, you must reencipher all disk copies of the CKDS under the new DES master key. Then you are ready to activate the master key. When you change the master key, you have ICSF replace the in-storage copy of the CKDS with the reenciphered disk copy. This also makes the new master key active on the system.

The procedures you use to activate the new master key depend on your system's compatibility mode. ICSF runs in noncompatibility, compatibility, or co-existence mode with the IBM cryptographic products, Cryptographic Unit Support Program (CUSP) and Programmed Cryptographic Facility (PCF). You specify which mode ICSF runs in by using an installation option. For a description of the modes and how to specify an installation option, see the *OS/390 ICSF System Programmer's Guide*.

In noncompatibility mode, ICSF allows you to change the master key with continuous operations. Therefore applications can continue to run without disruption. However, when ICSF is in compatibility mode or co-existence mode, you should use a different procedure to activate the changed master key. This is to ensure that no application is holding an internal token with the wrong master key.

In all three modes, you enter the new master key and reencipher the disk copy of the CKDS under the new master key using the master key panels. In noncompatibility mode, you then activate the new master key and refresh the in-storage copy of the CKDS with the disk copy using the master key panels or a utility program.

In compatibility mode and coexistence mode, however, activating the new master key and refreshing the in-storage copy of the CKDS does not reencipher internal key tokens under the new master key. ICSF applications that are holding internal key tokens which have been enciphered under the wrong master key will fail with a warning message. Applications that use the CUSP and PCF macros, run with no warning message and produce erroneous results.

The safest method to use after changing the master key in either compatibility or coexistence mode is as follows:

1. Ensure that the name of the new CKDS is in the installation data set.
2. Re-IPL MVS.
3. Start CSF.

A re-IPL ensures that a program does not access a cryptographic service that uses a key that is encrypted under a different master key. If a program is using an operational key, the program should either re-create or reimport the key, or generate a new key.

If a re-IPL is not practical in your installation, you can use this alternative method. Stop all cryptographic applications, especially those using CUSP or PCF macros, before activating the new master key and refreshing the in-storage copy of the CKDS. This eliminates all operational keys that are encrypted under the current master key. After you start CSF again, applications using an operational key can either re-create or reimport the key.

Changing the Master Key Using the Master Key Panels

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering Clear Master Key Parts” on page 57.

   The new master key register must be full before you change the master key.

2. Select option 3, CHANGE, on the Master Key Management panel, as shown in Figure 54, and press ENTER.

   Note: If your system is using two coprocessors, they must have the same master key. When you change the master key in one coprocessor, you should change the master key in the other coprocessor. Therefore, before you can reencipher a CKDS under a new master key, the new master key registers in both coprocessors must contain the same value.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  3


Enter the number of the desired option above.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 54. Selecting the Change Master Key Option on the ICSF Master Key Management Panel

The Change/Reencipher panel appears. See Figure 55.

```
CSFCMM00 ----------------- OS/390 ICSF - Change/Reencipher ----------------
OPTION  ===>


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 55. Change/Reencipher Panel

Before you change the master key, you must first reencipher the disk copy of the CKDS under the new master key.

3. To reencipher a disk copy, choose option 1 on the Change/Reencipher panel to access the Reencipher CKDS panel, which is shown in Figure 56 on page 82.

   The Reencipher CKDS panel appears. See Figure 56 on page 82.

```
CSFCMK10 ----------------- OS/390 ICSF - Reencipher CKDS ------------------
COMMAND ===>


To reencipher all CKDS entries from encryption under the current master key
to encryption under the new master key enter the CKDS names below.



   Input CKDS ===> CKDS.CURRENT.MASTER

   Output CKDS ===> CKDS.NEW.MASTER
```

Figure 56. Reencipher CKDS

4. In the Input CKDS field, enter the name of the CKDS that you want to reencipher. In the Output CKDS field, enter the name of the data set in which you want to place the reenciphered keys.

   Note: The output data set should already exist although it must be empty. For more information about defining a CKDS, see the *OS/390 ICSF System Programmer's Guide*.

   Reenciphering the disk copy of the CKDS does not affect the in-storage copy of the CKDS. On this panel, you are working with only a disk copy of the CKDS.

5. Press ENTER to reencipher the input CKDS entries and place them into the output CKDS.

   The message REENCIPHER SUCCESSFUL appears on the top right of the panel if the reencipher succeeds.

6. If you have more than one CKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the CKDS, you are ready to change the master key.

7. Press END to return to the Change/Reencipher panel.

   Changing the master key involves refreshing the in-storage copy of the CKDS with a disk copy and activating the new master key.

8. If you are running in compatibility or co-existence mode, *do not* select option 2, the Change option. To activate the changed master key when running in compatibility or co-existence mode, you need to re-IPL MVS and start ICSF. When you re-IPL MVS and start ICSF, you activate the changed master key and refresh the in-storage CKDS. To do this, you must exit the panels at this time.

9. If you are running in noncompatibility mode, to change the master key select option 2 on the Change/Reencipher panel, as shown in Figure 57 on page 83.

```
CSFCMM00 ----------------- OS/390 ICSF - Change/Reencipher ----------------
OPTION  ===> 2


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 57. Selecting the Change Master Key Option on the Change/Reencipher Panel

When you press the ENTER key, the Change Master Key panel appears. See Figure 58.

```
CSFCMK20 --------------------- OS/390 ICSF Change Master Key --------------
COMMAND ===>


Enter the name of the new CKDS below:

  New CKDS ===> CKDS.NEW.MASTER

When the master key is changed, the new CKDS will become active.
```

Figure 58. Change Master Key Panel

10. In the New CKDS field, enter the name of the disk copy of the CKDS that you ICSF to place in storage.

    You should have already reenciphered the disk copy of the CKDS under the new master key. The last CKDS name that you specified in the Output CKDS field on the Reencipher CKDS panel, which is shown in Figure 56 on page 82, automatically appears in this field.

11. Press ENTER.

    ICSF loads the data set into storage where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

    After you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that prevented the successful completion of the change process. For example, if you indicate a data set that is not reenciphered under the new master key, an error message displays, and the master key is not changed.

    Note: Each Cryptographic Coprocessor Feature includes two crypto modules, which ICSF recognizes as Coprocessor C0 and Coprocessor C1. You must enter the new master key into each of the coprocessors, before you perform the change. ICSF activates the new master key of both coprocessors that contain a new master key value that will encipher the CKDS.

    If only one coprocessor new master key value matches the new CKDS, then that coprocessor will be used. The other coprocessor will remain

offline until the new master key is changed to match the other coprocessor.

When the change occurs, the operator console receives messages that state that the Cryptographic Coprocessor Feature is off line and then online for each coprocessor. These actions should not affect cryptographic operations.

You can use a utility program to reencipher the CKDSs and change the master key instead of using the panels. “Reenciphering a Disk Copy of a CKDS and Changing the Master Key” on page 317 describes how to use the utility program for these procedures.

Changing the PKA Master Keys

Attention: Changing the PKA master keys will make all internal tokens in the current PKDS unusable. You will need to re-create the tokens in order to use them with the changed master key. When the PKDS is shared by multiple images in a sysplex environment, the PKA master key should also be changed on all the sharing systems.

To change the PKA master keys:

1. Access the user control functions by selecting option 7, USERCNTL, on the primary menu panel as shown in Figure 59.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 59. Selecting the User Control Functions on the ICSF Primary Menu Panel

The User Control Function panel appears. See Figure 60 on page 85.

```
CSFUFN00 ------------- OS/390 ICSF - User Control Functions
OPTION ===>

Enter the number of the desired option.

  Dynamic CKDS Access

  1  ALLOW       -  Allow Dynamic CKDS access
  2  DISALLOW    -  Disallow Dynamic CKDS access

  PKA Callable Services

  3  ENABLE      -  Enable PKA callable services
  4  DISABLE     -  Disable PKA callable services
```

Figure 60. Enabling and Disabling the PKA Callable Services

2. Disable the PKA callable services, by selecting option 4 and pressing ENTER.

   If you press PF3 on the USERCNTL panel, the primary menu panel appears.

3. Select option 1, MASTER KEY, and press ENTER.

   The Master Key Management panel appears.

4. Select option 1, CLEAR MASTER KEY ENTRY, and press ENTER.

   The Coprocessor Selection panel appears.

5. Select the coprocessor for PKA master key entry by typing the coprocessor number on the OPTION line and pressing ENTER.

   The Clear Master Key Entry panel appears. See Figure 61.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                Coprocessor selected for new master key   : C0
                New master key register status            : EMPTY
                PKA Key Management Master Key register    : FULL
                PKA Signature Master Key register         : FULL

 Specify information below
   Key Type  KMMK             (NMK, KMMK, SMK)

   Part      RESET_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 61. The Clear Master Key Entry Panel to Reset Registers

   You need to RESET to clear the contents of the registers before you can set a new key value.

6. When you select RESET, the Restart Key Entry Process panel is displayed. See Figure 62 on page 86.

   This panel confirms your request to restart the key entry process. Press ENTER.

```
CSFDKE40 -------------- OS/390 ICSF - Restart Key Entry Process -------------


ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


   Restarting the process will clear the KMMK   key register.


  WARNING:  Resetting the KMMK or SMK will invalidate any private
internal key tokens in the PKDS


Press ENTER to confirm restart request
Press END   to  cancel restart request
```

Figure 62. Confirm Restart Request Panel

7. The Clear Master Key Entry panel again appears. See Figure 63. Enter the type of PKA master key you are changing and enter the key part.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key   : 0
               New master key register status            : EMPTY
               PKA Key Management Master Key register    : EMPTY
               PKA Signature Master Key register         : FULL

 Specify information below
   Key Type  KMMK             (NMK, KMMK, SMK)

   Part      FINAL_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 59

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 9B28AEFA8C47760F   (KMMK, SMK only)
```

Figure 63. The Clear Master Key Entry Panel with Final Key Values

In this example, we are entering a KMMK and have entered FINAL for the key part since a PKA master key requires only one key part. You may enter additional key parts if necessary.

8. Type the key part value and the checksum.

   If you used the random number generator utility to generate the key part values just before starting the PKA master key change process, the key part values are transferred directly to this panel. This eliminates the need to retype these values.

9. When all the fields are complete, press ENTER.

   If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The PKA key management master key register status changes to `FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

10. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

    Note: If your system has two crypto's, you must repeat the PKA key entry process for the remaining crypto. You must enter the same key value on both crypto units. PKA callable services CANNOT be enabled if the keys on both cryptos do not match.

11. After you have changed the PKA master keys, go to the User Control Function panel and enable PKA callable services.

    If using a PKDS, you must also enable PKDSRead and PKDSWrite.

Clearing Master Keys

For security reasons, your installation may need to clear the master keys. This may be required, for example, before turning the processor hardware over for maintenance.

If you have a TKE workstation, you can use it to zeroize all domains that have keys loaded. Refer to *OS/390 ICSF TKE Workstation User's Guide* and *OS/390 ICSF TKE Workstation User's Guide 2000* for more information.

If you do not have a TKE workstation, you might want to consider nullifying the master keys. To do this you would need to enter a new DES master key (perhaps all zeros), reencipher a dummy CKDS, and change the master key. You would need to perform this operation twice to ensure that the master key is cleared from the auxiliary (old) master key register. You would also need to reset both of the PKA master keys.

You can also use the zeroize function on the Support Element panels. Besides clearing the master keys, this also clears all domains and user data.

Chapter 6. Managing Master Keys on the S/390 Enterprise Server with PCI Cryptographic Coprocessors

You can have multiple PCI Cryptographic Coprocessors on the S/390 G5 Enterprise Server with field upgrade or S/390 G6 Enterprise Server with field upgrade. Each PCI Cryptographic Coprocessor is capable of performing cryptographic functions and holding the master keys within a secure boundary. The PCI Cryptographic Coprocessors work in conjunction with the S/390 Cryptographic Coprocessor Features on your server. Requests for cryptographic services are routed to either the PCI Cryptographic Coprocessor or the Cryptographic Coprocessor Feature depending on key types specified in the request. In order for these two types of cryptographic coprocessors to work together, you need to install the same master key values for each coprocessor. This chapter describes how to use the master key entry panels to enter master keys in both types of cryptographic coprocessor.

For information on using the clear master key entry panels to enter master keys into a server with only Cryptographic Coprocessor Features, refer to Chapter 5, “Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise” on page 57.

Entering Clear Master Key Parts

You can use the Clear Master Key Entry panels to enter clear master key parts. The way you obtain master key parts depends on the security guidelines in your enterprise. You may receive master key parts from a key distribution center or you may generate your own key parts using the ICSF random number utility.

When you enter the PKA master keys and the asymmetric-keys master key (ASYM-MK) the first time, the PKA callable services are initially disabled. Once you have entered the PKA master keys and the ASYM-MK, you must enable the PKA callable services for these services to work. Before you change the PKA master keys and the ASYM-MK, you need to disable the PKA callable services. To enable and disable the PKA callable services refer to “Enabling and Disabling PKA Services.”

To enter master key parts that you do not generate using the random number utility, continue with “Entering the First Master Key Part” on page 97.

To begin master key entry by generating random numbers for the key parts, continue with “Generating Master Key Data for Clear Master Key Entry” on page 90.

Enabling and Disabling PKA Services

When you enter or change the PKA master keys, or the ASYM-MK you must first disable the PKA services. To enable or disable PKA services:

1. Access the user control functions by choosing option 7, USERCNTL, on the Primary Menu panel, as shown in Figure 64 on page 90.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 64. Selecting the Utility Option on the ICSF Primary Menu Panel

The User Control Function panel appears. See Figure 65.

```
CSFUFN00 ------------- OS/390 ICSF - User Control Functions
OPTION ===>

Enter the number of the desired option.

  Dynamic CKDS Access
  1  Allow
  2  Disallow

  PKA Callable Services
  3  Enable
  4  Disable

  PKDS Read Access
  5  Allow
  6  Disallow

  PKDS Write, Create, and Delete Access
  7  Allow
  8  Disallow
```

Figure 65. Enabling and Disabling the PKA Callable Services

2. Enter the option and press ENTER.
   - To enable the PKA callable services, select option 3, ENABLE

     Note: If using a PKDS, you must also enable PKDSRead and PKDSWrite.
   - To disable the PKA callable services, select option 4, DISABLE.

Generating Master Key Data for Clear Master Key Entry

If you intend to use the clear key entry panels to enter master keys, you need to generate and record the following values before you begin:

- Key parts
- Checksums
- Verification patterns (optional)
- Hash patterns (optional)

Note: If you are reentering master keys after they have been cleared, use the same master key part values as when you originally entered the keys. You should have saved the key part values in a secure place after you entered the master keys previously.

A DES master key is 16 bytes long. A symmetric-keys master key (SYM-MK) is 24 bytes long. ICSF enforces the SYM-MK to be 16 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. Each of the master key parts is also 16 bytes long. To enter either a DES master key or a SYM-MK, you must enter a first key part and a final key part. If you choose to, you can also enter one or more intermediate key parts after entering the first key part and before entering the final key part.

Note: The combined DES master key or SYM-MK is forced to have odd parity, but the parity of the individual key parts can be odd, even or mixed. We refer to even or mixed parity keys as non-odd parity keys.

PKA master keys and the ASYM-MKs are each 24 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. Each of the key parts is also 24 bytes long. These master keys are not parity adjusted.

Note: It is recommended that you enter the same key value for the SMK and KMMK of the Cryptographic Coprocessor Feature and the ASYM-MK of the PCI Cryptographic Coprocessor Feature. This will allow ICSF flexibility in workload balancing.

If you are using ICSF to generate random numbers, generate a random number for each key part that you need to enter to create the master key.

A 16-byte key part consists of 32 hexadecimal digits. A 24-byte key part consists of 48 hexadecimal digits. To make this process easier, each part is broken into segments of 16 digits each.

When you are manually entering the master key parts, you also enter a checksum that verifies whether you entered the key part correctly. A checksum is a two-digit result of putting a key part value through a series of calculations. Both the Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessor calculate the checksum with the key part you enter and compare the one it calculated with the one you entered. The checksum verifies that you did not transpose any digits when entering the key part. If the checksums are equal, you have successfully entered the key.

After you enter a key part and its checksum for a DES master key, the Cryptographic Coprocessor Feature calculates an eight-byte verification pattern and a sixteen-byte hash pattern . After you enter a key part and its checksum for a PKA master key, the Cryptographic Coprocessor Feature calculates a sixteen-byte hash pattern. The ICSF Clear Master Key Entry panel displays the verification pattern and hash pattern for DES master key parts and displays the hast pattern for PKA master key parts.

Before the verification and hash patterns can be calculated, the DES master key must have been set.

Check the displayed verification pattern against the optional verification pattern you may have generated at the time you generated the DES master key part and the checksum. Check the displayed hash pattern against the optional hash pattern that you may have generated at the same time you generated the PKA master key part and the checksum. The verification pattern or hash pattern checks whether you entered the key part correctly, and whether you entered the correct key type. ICSF displays a verification pattern for each DES master key part. It also displays a

verification pattern and hash pattern for the DES master key after you enter all the key parts. If the verification patterns are the same, you have entered the key part correctly. Likewise, in addition to displaying a hash pattern for each PKA master key part, ICSF also displays a hash pattern for the PKA master key after you enter all the key parts. If the hash patterns are the same, you have entered the key part correctly.

Note: Keys stored in the CKDS are enciphered under the DES master key. The master key verification pattern is stored in the CKDS header record. Checking the verification pattern is optional; it is not required for key entry.

After you enter a key part and its checksum for a SYM-MK, the PCI Cryptographic Coprocessor calculates an eight-byte verification pattern and a sixteen-byte hash pattern. After you enter a key part and its checksum for an ASYM-MK, the PCI Cryptographic Coprocessor calculates a sixteen-byte hash pattern. The ICSF Clear Master Key Entry panel displays the verification patterns. Check the displayed verification patterns against the optional verification patterns you may have generated at the time you generated the SYM-MK or ASYM-MK key parts and the checksums. The verification pattern checks whether you entered the key part correctly, and whether you entered the correct key type. ICSF displays a verification and hash pattern for each SYM-MK. It displays a hash pattern for each ASYM-MK key part. It also displays a verification pattern for each of these master keys after you enter all the key parts. If the verification patterns are the same, you have entered the key parts correctly.

To generate the value for a key part, you can use one of the following methods:

- Choose a random number yourself.
- Access the ICSF utility panels to generate a random number.
- Call the random number generate callable service. For more information, see the *OS/390 ICSF Application Programmer's Guide*.

  Note: ICSF must be initialized with a DES master key before you can use the random number generate callable service or the Random Number Generator panel.

The following topics describe using the ICSF utilities to generate key parts, checksums, verification patterns, and hash patterns.

Generating Key Parts Using ICSF Utilities

1. Access ICSF utilities by choosing option 5, UTILITY, on the Primary Menu panel, as shown in Figure 66 on page 93.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 66. Selecting the Utility Option on the ICSF Primary Menu Panel

The Utilities panel appears. See Figure 67. You use the RANDOM and CHECKSUM options to generate random numbers, checksums, and verification patterns for master key management.

Before the verification and hash patterns can be calculated, the DES master key must have been set.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities --------------------------
OPTION ===> 3


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                       hash pattern
```

Figure 67. ICSF Utilities Panel

2. Choose option 3, RANDOM, to access the Random Number Generator panel, shown in Figure 68.

```
CSFRNG00 ---------------- OS/390 ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 0000000000000000  Random Number 1
  Random Number2    : 0000000000000000  Random Number 2
  Random Number3    : 0000000000000000  Random Number 3
```

Figure 68. ICSF Random Number Generator Panel

3. To select the parity of the random numbers, enter ODD, EVEN, or RANDOM next to Parity Option and press ENTER.

   The DES master key and SYM-MK are each forced to have odd parity, regardless of the parity option you select for each key part.

   A random 16-digit number appears in each of the Random Number fields. You can use each of these random numbers for a segment of a key part.

Note: The third random number is only for PKA master keys or the ASYM-MK. It is not used for DES master keys, SYM-MKs, or operational keys.

```
CSFRNG00 ---------------- OS/390 ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 51ED9CFA90716CFB  Random Number 1
  Random Number2    : 58403BFA02BD13E8  Random Number 2
  Random Number3    : 9B28AEFA8C47760F  Random Number 3
```

Figure 69. ICSF Random Number Generator Panel with Generated Numbers

4. *Record the random numbers* so you can store them in a safe place. If you ever need to reenter a master key that has been cleared for any reason, you will need the key part values.

   After you end the utility panels and access the Clear Master Key Part Entry panel, the key parts you generated are transferred automatically to the Clear Master Key Part Entry panels. For this reason, you will not need to enter the key parts on the Clear Master Key Part Entry panels.

5. Press END to return to the Utilities panel.
6. Continue with Generating a Checksum, Verification Pattern, or Hash Pattern for a Key Part.

Generating a Checksum, Verification Pattern, or Hash Pattern for a Key Part

You can use the ICSF utilities panel to generate a checksum and either an optional verification pattern or an optional hash pattern for a key part. You can use this panel to generate a checksum for a key part even if ICSF has not been initialized. The random number generator and the verification pattern, however, do not work until ICSF has been initialized with a valid master key.

Note: The use of these utility panels to generate the key part, the checksum, and the verification pattern exposes the key part in storage for the duration of the dialogs. For this reason, you can choose to calculate both the checksum, the verification pattern or the hash pattern values manually or by using a PC program. See “Checksum Algorithm” on page 325 for a description of the checksum algorithm. See “Algorithm for Calculating a Verification Pattern” on page 327 for a description of the algorithm for the verification pattern. See “The MDC–4 Algorithm for Generating Hash Patterns” on page 328 for a description of the MDC-4 algorithm that is used to calculate a hash pattern for a key part. The use of the verification pattern or hash pattern is optional.

Follow these steps to generate a checksum and the optional verification pattern or hash pattern for a key part.

1. Select option 4, CHECKSUM, on the ICSF Utilities panel as shown in Figure 70 on page 95.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities ------------------------
OPTION ===> 4


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
```

Figure 70. Selecting the Checksum Option on the ICSF Utilities Panel

The Checksum and Verification Pattern panel appears. See Figure 71.

```
CSFMKV00 ------------ OS/390 ICSF - Checksum and Verification Pattern -----
COMMAND ===>


Enter data below:

  Key Type        ===>                   (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 9B28AEFA8C47760F  Input last key part (PKA keys only)

  Checksum           : 00                Check digit for key part
  Key Part VP        : 0000000000000000  Verification Pattern

  Key Part HP        : 0000000000000000  Hash Pattern
                     : 0000000000000000
```

Figure 71. ICSF Checksum and Verification Pattern Panel

If you accessed the Random Number Generator panel before this panel, the random numbers that are generated appear automatically in the Key Part fields. You can skip the next step.

2. If you did not use the ICSF panels to generate random numbers, enter the numbers for which you want to create checksum, verification pattern, or hash patterns into these fields.
3. In the Key Type field, specify either:
   - MASTER to generate a checksum, verification pattern and hash pattern for a DES master key part or a SYM-MK key part.
   - PKAMSTR to generate a checksum and hash pattern for a PKA master key part or to generate a checksum and a hash pattern for an ASYM-MK.

   If you leave the Key Type field blank and press ENTER, the Key Type Selection panel appears. See Figure 72 on page 96.

```
CSFMKV10 --------- OS/390 ICSF - Key Type Selection Panel ---- ROW 1 to 9 OF 9
COMMAND ===>                                                  SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   EXPORTER   Export key-encrypting key
   IMP-PKA    Limited authority importer
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
s  MASTER     DES master key
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
   PKAMSTR    PKA master key
****************************** BOTTOM OF DATA *******************************
```

Figure 72. Key Type Selection Panel Displayed During Hardware Key Entry

4. Type s to the left of the MASTER key type, and press ENTER to return to the Checksum and Verification Pattern panel as shown in Figure 73.

   In this example, we have selected the DES master key.

```
CSFMKV00 ------ OS/390 ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

  Key Type        ===> MASTER            (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 9B28AEFA8C47760F  Input last key part (PKA keys only)

  Checksum           : 00                Check digit for key part
  Key Part VP        : 0000000000000000  Verification Pattern

  Key Part HP        : 0000000000000000  Hash Pattern
                     : 0000000000000000
```

Figure 73. ICSF Checksum and Verification Pattern Panel

5. On the Checksum and Verification Pattern panel, press ENTER.

   ICSF calculates the checksum, verification pattern, and hash pattern for the key part segments and displays them on the panel as shown in Figure 74 on page 97. Since a DES master key was selected for this example, the key part last segment was not used in the calculations. The key part last field is zeroed out on the panel. For a PKA master key, ICSF uses all three key part segments to calculate the checksum and hash pattern.

```
CSFMKV00 ------ OS/390 ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

  Key Type        ===> MASTER            (Selection panel displayed if blank)

  Key Part First  ===> 51ED9CFA90716CFB  Input first key part
  Key Part Middle ===> 58403BFA02BD13E8  Input middle key part
  Key Part Last   ===> 0000000000000000  Input last key part (PKA keys only)

  Checksum           : 40                Check digit for key part
  Key Part VP        : 0CCE190A635A6C89  Verification Pattern
  Key Part HP        : EA58E51179754FB7  Hash Pattern
                     : C102957465CE479E
```

Figure 74. Checksum, Verification Pattern, and Hash Pattern Calculated for a DES Master Key Part

6. *Record the checksum, verification pattern, and hash pattern.*

   Save these values in a secure place along with the key part values in case of a tamper. If the Cryptographic Coprocessor Feature detects tampering, it clears the master key, and you have to reenter the same master key again.

   If the PCI Cryptographic Coprocessor Feature detects tampering (the intrusion latch is tripped), it clears the master key, and you have to reenter the same master key again.

   If the PCI Cryptographic Coprocessor Feature detects tampering (the secure boundary of the card is compromised), it self-destructs and can no longer be used.

7. Press END to return to the Utilities panel.
8. Press END again to return to the ICSF Primary menu.

Continue with the appropriate section for steps to enter the master key part you have just generated.

- If you have generated the first master key part, continue with “Entering the First Master Key Part.”
- If you have generated an intermediate master key part, continue with “Entering Intermediate Key Parts” on page 103.
- If you have generated a final master key part, continue with “Entering the Final Key Part” on page 107.

Entering the First Master Key Part

Use the Clear Master Key Entry panels to enter each key part. If you use the random number generator utility to generate key parts, enter each key part directly into the Cryptographic Coprocessor Features after you generate the key part data and before generating another key part. Once you have completed entering a key part into the Cryptographic Coprocessor Features, you should immediately enter the same key part into the PCI Cryptographic Coprocessors. If you follow this sequence, the key parts you generate are transferred directly to the Clear Master Key Entry panel, eliminating the need to type in the values. This avoids errors that can result when typing in key part values manually.

To enter master key parts:

1. Select option 1, MASTER KEY, on the ICSF Primary menu, as shown in Figure 75, and press ENTER.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 75. ICSF Selecting the Master Key Option on the Primary Menu Panel

The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel, as shown in Figure 76.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 76. Selecting the Enter Option on the Master Key Management Panel

The Master Key Coprocessor Selection panel appears. See Figure 77 on page 99.

3. Enter 1, Cryptographic Coprocessor Feature Clear Master Key Entry and press ENTER.

   Note: To use the Trusted Key Entry workstation, refer to the *OS/390 ICSF TKE Workstation User's Guide* or *OS/390 ICSF TKE Workstation User's Guide 2000*.

```
CSFMKM20 -------- OS/390 ICSF - Master Key Coprocessor Selection ---------
 OPTION ===> 1

  Enter the number of the desired option.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels.

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 77. Selecting the Coprocessor for Master Key Entry on the Master Key Coprocessor Selection Panel

The Coprocessor Selection panel appears. It may be similar to the one in Figure 78. For a description of the status parameters that are defined on this panel, refer to “Displaying Hardware Status” on page 285.

4. Select the coprocessor for master key entry by typing the number on the OPTION line and pressing ENTER.

   Note: If you have only one Cryptographic Coprocessor Feature installed, or if there is only one defined to this LP, this panel will only show one coprocessor.

```
CSFMKP11 --------------- OS/390 ICSF - Coprocessor Selection----------
OPTION ===> 0
                                                          CRYPTO DOMAIN: 0

Enter the number of the coprocessor to be used for key entry.

REGISTER STATUS              0. COPROCESSOR C0       1. COPROCESSOR C1

                                                                  MORE:     +
  Crypto Module ID           : E589C39694407A60     : C39997A396F1407A
                             : 5D40C39997A396F0     : 605D40E589C39694
  Crypto CPs installed       : 1                    : 3
  Crypto CPs active          : 1                    : 3
  Key Part register          : DISABLED AND EMPTY   : DISABLED AND EMPTY
  New Master Key register    : EMPTY                : EMPTY
  NMK verification pattern   :                      :
  Old Master Key register    : EMPTY                : EMPTY
  OMK verification pattern   :
  Old/New Master Key register:
      hash pattern
Press ENTER to select a coproceesor and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 78. Coprocessor Selection Panel

After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. See Figure 79 on page 100.

```
 CSFDKE10 ------ OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                   Coprocessor selected for master key entry: C0
                   New master key register status           : EMPTY
                   PKA Key Management Master Key register   : EMPTY
                   PKA Signature Master Key register        : EMPTY
  Specify information below

    Key Type  ___              (NMK, KMMK, SMK)

    Part      ______           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  40

    Key Value ===> 51ED9CFA90716CFB
              ===> 58403BFA02BD13E8
              ===> 0000000000000000   (KMMK, SMK only)

  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 79. The Clear Master Key Entry Panel with Key Value Data Transferred from the Random Number Generator

5. Enter the master key type in the Key Type field.

   In this example we show entering a new master key (NMK). This is the DES master key.

6. Enter FIRST in the Part field.

   If you have just used the random number generator utility to generate a key part, ICSF transfered the checksum and the key value directly to this screen. You do not need to enter these values so you can skip the next step.

7. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.

8. When all the fields are complete, press ENTER.

   If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculates, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 80 on page 101. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

9. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

```
CSFDKE10 ------------ OS/390 ICSF - Clear Master Key Entry ----- KEY PART LOADED
COMMAND ===>
                  Coprocessor selected for master key entry: C0
                  New master key register status           : PART FULL
                  PKA Key Management Master Key register   : EMPTY
                  PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  NMK_             (NMK, KMMK, SMK)

   Part      FIRST_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)

 Entered key part VP:  0CCE190A635A6C89  HP: EA58E51179754FB7  C102957465CE479E

                    (Record and secure these patterns)
 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 80. The Clear Master Key Entry Panel Following Key Part Entry from the Random Number Generator

If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:

a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

10. When you have successfully entered the key part into the Cryptographic Coprocessor Feature, you can then enter the same key part into one, or all, of the PCI Cryptographic Coprocessors. To begin this process, press END to return to the previous menu, the Master Key Coprocessor Selection panel. This time select either option 3 to enter the key part into a specific PCI Cryptographic Coprocessor, or option 4 to enter the key part into all online PCI Cryptographic Coprocessors. In the example in Figure 81 on page 102, we have selected option 4.

    It is recommended that you select option 4.

```
CSFMKM20 -------- OS/390 ICSF - Master Key Coprocessor Selection ---------
 OPTION ===> 4

  Enter the number of the desired option.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels.

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 81. Selecting the PCI Cryptographic Coprocessor for Master Key Entry on the Master Key Coprocessor Selection Panel

11. The PCICC Clear Master Key Entry panel appears. Refer to Figure 82. Note that the checksum and key part values used for the Cryptographic Coprocessor Feature appear on this panel, so there is no need to reenter them.

```
CSFDKE11 -------- OS/390 ICSF - PCICC Clear Master Key Entry ------
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : EMPTY
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  ____             (SYM-MK, ASYM-MK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (ASYM-MK only)

 Entered key part VP:  0CCE190A635A6C89  HP: EA58E51179754FB7  C102957465CE479E
                      (Record and secure these patterns)

  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 82. The PCICC Clear Master Key Entry Panel

12. Enter the master key type in the Key Type field.

    In this example we show entering a symmetric-keys master key (SYM-MK).

13. Enter FIRST in the Part field.

14. When all the fields are complete, press ENTER.

    If the checksum entered in the checksum field matches the checksum that the PCI Cryptographic Coprocessor calculates, the key part is accepted. The message at the top of the panel states KEY PART LOADED, as shown in Figure 83 on page 103. The new master key register status changes to PART

FULL. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

15. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter. Also, check that the verification and hash patterns are the same as those generated for this same key part on the Cryptographic Coprocessor Feature.

```
CSFDKE11 ------- OS/390 ICSF - PCICC Clear Master Key Entry ----- KEY PART LOADED
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : PART FULL
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  SYM-MK           (SYM-MK, ASYM-MK)

   Part      FIRST_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (ASYM-MK only)

 Entered key part VP:  0CCE190A635A6C89  HP: EA58E51179754FB7  C102957465CE479E

                    (Record and secure these patterns)
 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 83. The PCICC Clear Master Key Entry Panel

When you have entered the first key part successfully in both the Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessors, continue with:

- "Generating Key Parts Using ICSF Utilities" on page 92 if you are using the ICSF utilities to generate random numbers for key values.
- "Entering Intermediate Key Parts" if you are entering an intermediate key part manually.
- "Entering the Final Key Part" on page 107 if you are entering a final key part manually.

Entering Intermediate Key Parts

If you want to enter more than two key parts, you must enter one or more intermediate key parts. Enter intermediate key parts after you enter the first key part and before you enter the final one.

To enter intermediate master key parts:

1. Select option 1, MASTER KEY, on the ICSF Primary menu and press ENTER.

   The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel.

   The Master Key Coprocessor Selection panel appears.

3. Select option 1 for Cryptographic Coprocessor Feature Clear Master Key Entry and press ENTER.

The Coprocessor Selection panel appears.

4. Select the coprocessor.

   After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. See Figure 84. If you used the random number generator utility to generate key part data just before accessing the PCICC Clear Master Key Entry panel, the key part values and checksum are transferred directly to this panel. This eliminates the need to retype these values.

```
CSFDKE11 ----------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                  Coprocessor selected for master key entry: C0
                  New master key register status           : PART FULL
                  PKA Key Management Master Key register   : EMPTY
                  PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  ____             (NMK, KMMK, SMK)

   Part      MIDDLE           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 84. The Clear Master Key Entry Panel with Intermediate Key Values

5. Enter the master key type in the Key Type field.

   In this example we show entering the new master key (NMK).

6. Enter MIDDLE in the Part field.

   If you have just used the random number generator utility to generate a key part, the checksum and the key value are transferred directly to this screen. You do not need to enter these values, so you can skip the next step.

7. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.

8. When all the fields are complete, press ENTER.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                Coprocessor selected for new master key   : C0
                New master key register status            : PART FULL
                PKA Key Management Master Key register    : EMPTY
                PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  NMK_             (NMK, KMMK, SMK)

   Part      MIDDLE           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (KMMK, SMK only)

 Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679

                    (Record and secure these patterns)
```

Figure 85. The Clear Master Key Entry Panel with Intermediate Key Values

If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculates, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The new master key register status continues to indicate `PART FULL`. The verification pattern and hash pattern that the Cryptographic Coprocessor Feature calculated for the key part appear near the bottom of the panel. See Figure 45 on page 69.

9. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

   If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:

   a. Reenter the checksum.

   b. If you still get a checksum error, recalculate the checksum.

   c. If your calculations result in a different value for the checksum, enter the new value.

   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

10. When you have successfully entered the intermediate key part into the Cryptographic Coprocessor Feature, you can then enter the same key part into one, or all, of the PCI Cryptographic Coprocessors. To begin this process, press END to return to the previous menu, the Master Key Coprocessor Selection panel.

11. This time select either option 3 to enter the key part into a specific PCI Cryptographic Coprocessor, or option 4 to enter the key part into all online PCI Cryptographic Coprocessors. It is recommended that you select option 4. In the example in Figure 86 on page 106, we have selected option 4.

```
CSFMKM20 -------- OS/390 ICSF - Master Key Coprocessor Selection ---------
 OPTION ===> 4

  Enter the number of the desired option.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels.

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 86. Selecting the PCI Cryptographic Coprocessor for Master Key Entry on the Master Key Coprocessor Selection Panel

12. The PCICC Clear Master Key Entry panel appears. Refer to Figure 87. Note that the checksum and key part values used for the Cryptographic Coprocessor Feature appear on this panel, so there is no need to reenter them.

```
CSFDKE11 ---------- OS/390 ICSF - PCICC Clear Master Key Entry -----
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : PART FULL
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  ____             (SYM-MK, ASYM-MK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (ASYM-MK only)


  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 87. The PCICC Clear Master Key Entry Panel

13. Enter the master key type in the Key Type field.

    In this example we show entering a symmetric-keys master key (SYM-MK).

14. Enter MIDDLE in the Part field.

15. When all the fields are complete, press ENTER.

    If the checksum entered in the checksum field matches the checksum that the PCI Cryptographic Coprocessor calculates, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 88 on page 107. The new master key register status changes to `PART`

FULL. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

16. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter. Also, check that the verification and hash patterns are the same as those generated for this same key part on the Cryptographic Coprocessor Feature.

```
CSFDKE11 ------- OS/390 ICSF - PCICC Clear Master Key Entry ----- KEY PART LOADED
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : PART FULL
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  SYM-MK           (SYM-MK, ASYM-MK)

   Part      MIDDLE_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  4F

   Key Value ===> 834B4864BA8E8B68
             ===> FA3C8664FBC93A0D
             ===> 0000000000000000   (ASYM-MK only)

Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679

                    (Record and secure these patterns)
  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 88. The PCICC Clear Master Key Entry Panel

When you have entered the middle key part successfully, continue with:

- "Generating Key Parts Using ICSF Utilities" on page 92 if you are using the ICSF utilities to generate random numbers for key values.
- "Entering Intermediate Key Parts" on page 103 if you are entering another intermediate key part manually.
- "Entering the Final Key Part" if you are entering a final key part manually.

Entering the Final Key Part

After you enter the first key part, and any intermediate key parts into the Cryptographic Coprocessor Features and the PCI Cryptographic Coprocessors, you then enter the final master key part as explained here:

1. Select option 1, MASTER KEY, on the ICSF Primary menu and press ENTER.

   The Master Key Management panel appears.

2. Select option 1, ENTER, on the Master Key Management panel.

   The Master Key Coprocessor Selection panel appears.

3. Select option 1 for Cryptographic Coprocessor Feature Clear Master Key Entry and press ENTER.

   The Coprocessor Selection panel appears.

4. Select the coprocessor for master key entry by typing the number on the OPTION line and pressing ENTER.

After you select a coprocessor and press ENTER, the Clear Master Key Entry panel appears. If you used the random number generator utility to generate key part values just before accessing the Clear Master Key Entry panel, the key part values are transferred directly to this panel. This eliminates the need to retype these values.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                Coprocessor selected for new master key   : C0
                New master key register status            : PART FULL
                PKA Key Management Master Key register    : EMPTY
                PKA Signature Master Key register         : EMPTY

 Specify information below
   Key Type  ____             (NMK, KMMK, SMK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 99

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 0000000000000000   (KMMK, SMK only)



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 89. The Clear Master Key Entry Panel with Final Key Values

5. Enter the master key type in the Key Type field.

   In this example we show entering the new master key (NMK).

6. Enter FINAL in the Part field.

   If you have just used the random number generator utility to generate a key part, the checksum and the key value are transferred directly to this screen. You do not need to enter these values, so you can skip the next step.

7. If you are entering the key parts manually, enter the two-digit checksum and the two 16-digit key values.

8. When all the fields are complete, press ENTER.

```
CSFDKE10 ------------- OS/390 ICSF - Clear Master Key Entry ----- KEY PART LOADED

COMMAND ===>
                 Coprocessor selected for new master key  : C0
                 New master key register status           : FULL
                 PKA Key Management Master Key register   : EMPTY
                 PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  NMK_             (NMK, KMMK, SMK)

   Part      FINAL_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 99

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 0000000000000000   (KMMK, SMK only)

 Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679

                    (Record and secure these patterns)
NEED HP VP for key part and final key
```

Figure 90. The Clear Master Key Entry Panel with Final Key Values

If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculates, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The new master key register status changes to `FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

If the checksums do not match, the message `INVALID CHECKSUM` appears. If this occurs, follow this sequence to resolve the problem:

a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

9. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.

   When you have entered the final key part successfully, it is combined with the first key part and any intermediate key parts in the new master key register.

   The new master key register status is now FULL, and the panel displays two verification patterns and two hash patterns. It gives you verification patterns and hash patterns for both the final key part and the new master key, since it is now complete.

10. Check that the key part verification pattern or hash pattern you may have previously calculated matches the verification pattern or hash pattern that is shown on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see “Restarting the Key Entry Process” on page 72.

11. *Record the verification pattern and hash pattern* for the new master key, because you may want to verify it at another time.

    Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the DES master key into the CKDS header record.

12. When you have successfully entered the final key part into the Cryptographic Coprocessor Feature, you can then enter the same key part into one, or all, of the PCI Cryptographic Coprocessors. To begin this process, press END to return to the previous menu, the Master Key Coprocessor Selection panel.

13. Select either option 3 to enter the key part into a specific PCI Cryptographic Coprocessor, or option 4 to enter the key part into all online PCI Cryptographic Coprocessors. It is recommended that you use option 4. In the example in Figure 91, we have selected option 4.

```
CSFMKM20 -------- OS/390 ICSF - Master Key Coprocessor Selection ---------
 OPTION ===> 4

  Enter the number of the desired option.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels.

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 91. Selecting the PCI Cryptographic Coprocessor for Master Key Entry on the Master Key Coprocessor Selection Panel

14. The PCICC Clear Master Key Entry panel appears. Refer to Figure 92 on page 111. Note that the checksum and key part values used for the Cryptographic Coprocessor Feature appear on this panel, so there is no need to reenter them.

```
CSFDKE11 ---------- OS/390 ICSF - PCICC Clear Master Key Entry -----
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : PART FULL
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  ____             (SYM-MK, ASYM-MK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  99

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 0000000000000000   (ASYM-MK only)



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 92. The PCICC Clear Master Key Entry Panel

15. Enter the master key type in the Key Type field.

    In this example we show entering a symmetric-keys master key (SYM-MK).

16. Enter FINAL in the Part field.

17. When all the fields are complete, press ENTER.

    If the checksum entered in the checksum field matches the checksum that the PCI Cryptographic Coprocessor calculates, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 93 on page 112. The new master key register status changes to `FULL`. The symmetric-keys master key register status is now FULL, and the panel displays two verification patterns and two hash patterns. It gives you verification patterns and hash patterns for both the final key part and the symmetric-keys master key, since it is now complete.

18. *Record the verification pattern and hash pattern.* Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter. Also, check that the verification and hash patterns are the same as those generated for this same key part and the final key on the Cryptographic Coprocessor Feature.

```
CSFDKE11 ------- OS/390 ICSF - PCICC Clear Master Key Entry ----- KEY PART LOADED
COMMAND ===>
                  Coprocessor selected for master key entry     : ALL ONLINE
                  Symmetric-keys New master key register status : FULL
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  SYM-MK           (SYM-MK, ASYM-MK)

   Part      FINAL_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  99

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 0000000000000000   (ASYM-MK only)

Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679
NEED VP and HP for both key part and final key
                    (Record and secure these patterns)
  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 93. The PCICC Clear Master Key Entry Panel

When you have entered the DES master key correctly, it is in the new master key register in the Cryptographic Coprocessor Feature and is not active on the system yet. Also, when you have entered the SYM-MK correctly, it is in the new SYM-MK register of the PCI Cryptographic Coprocessor and is not active on the system

Note: If you have more than one crypto units installed, ensure that the new master key is installed on all crypto units.

After you enter the DES master key and the SYM-MK, you should do *one* of the following:

- If you are defining the DES master key and the SYM-MK for the first time, initialize the CKDS with the DES master key. For a description of the process of initializing a DES master key on your system, see “Initializing the CKDS at First-Time Startup” on page 114.
- If you are defining a DES master key after it was cleared, set the DES master key to make it active. For a description of the process of recovering from tampering, see “Reentering Master Keys After They have been Cleared” on page 118.
- If you are changing a DES master key, reencipher the CKDS under the new DES master key and make it active. For a description of the process of changing a DES master key, see “Changing Master Keys” on page 120.

When you have entered the PKA master keys and the ASYM-MK correctly, the PKA master key registers and the ASYM-MK registers are active when the final key part is loaded. To use PKA callable services, however, you have to enable this service option on the User Control Function panel. If this is the first-time load of the PKA registers or if you had explicitly disabled PKDSRead and PKDSWrite, you will also need to enable PKDSRead and PKDSWrite. For information on enabling PKA callable services, see “Enabling and Disabling PKA Services” on page 89.

Restarting the Key Entry Process

If you realize that you made an error when entering a key part, you can restart the process of entering the new master key. For example, if the verification pattern or the hash pattern that the Cryptographic Coprocessor Feature (CCF) or PCI Cryptographic Coprocessor (PCICC) calculates does not match the one that you calculated, you may want to restart the process. Restarting the key entry process clears the new master key register, which erases all the new master key parts you entered previously.

Note: If you are using a CCF, when you enter the first key part, your old master key is lost, even if you restart the process.

To restart the key entry process, follow the steps below:

1. On the Clear Master Key Entry panel, enter the master key type in the Key Type field.

   In this example, we are entering a new DES master key (NMK).

2. Enter RESET in the Part field.
3. Press ENTER.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                  Coprocessor selected for master key entry: C0
                  New master key register status           : PART FULL
                  PKA Key Management Master Key register   : EMPTY
                  PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  NMK              (NMK, KMMK, SMK)

   Part      RESET_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 94. Selecting Reset on the Clear Master Key Entry Panel

The Restart Key Entry Process panel appears. See Figure 95.

```
CSFEKM30 -------------- OS/390 ICSF - Restart Key Entry Process -------------
COMMAND ===>

ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the new master key register.




Press ENTER to confirm restart request
Press END   to cancel restart request
```

Figure 95. Confirm Restart Request Panel

This panel confirms your request to restart the key entry process.

Note: If you are restarting the key entry process for one of the PKA master keys, the panel message will differ. ICSF substitutes either “KMMK register” or “SMK register” for “the new master key register” phrase in the panel message.

4. If you want to restart the key entry process, press ENTER.

   The restart request automatically empties the master key register.

5. If you do not want to restart, press END.

   After you make a choice, you return to the Clear Master Key Entry panel. If you selected to continue with the restart process, the new master key register status field is reset to EMPTY, as shown in Figure 96. This indicates that the register has been cleared.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
                  Coprocessor selected for master key entry: C0
                  New master key register status           : EMPTY
                  PKA Key Management Master Key register   : EMPTY
                  PKA Signature Master Key register        : EMPTY

 Specify information below
   Key Type  ___              (NMK, KMMK, SMK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  40

   Key Value ===> 51ED9CFA90716CFB
             ===> 58403BFA02BD13E8
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 96. The Clear Master Key Entry Panel Following Reset Request

6. Either begin the key entry process again or press END to return to the ICSF primary menu panel.

   Resetting the SYM-MK and the ASYM-MK can be done thru the PCICC Clear Master Key Entry panel. However, you must be aware of several things. You cannot reset the new ASYM-MK register after the final key part is loaded because the ASYM-MK is automatically set. You may reset the new ASYM-MK register if the status is part-full. If the new ASYM-MK register is EMPTY, just start from entering the first key part.

Initializing the CKDS at First-Time Startup

The first time you start ICSF, you must enter a DES master key into the Cryptographic Coprocessor Feature, enter a SYM-MK into the PCI Cryptographic Coprocessors, create a cryptographic key data set (CKDS), and initialize the CKDS. When you initialize the CKDS, ICSF creates a header record for the CKDS, installs the required system keys in the CKDS, and sets the DES master key and SYM-MK. Keys stored in a CKDS are enciphered under the DES master key.

After you define the DES master key and initialize a CKDS, you can generate or enter any additional system keys you need to perform cryptographic functions.

There are four different types of system keys you can install in the CKDS:

- Required SYSTEM keys are automatically generated when you first initialize the CKDS. These include the MAC and MACVER keys that ICSF uses to generate and validate the MAC code in each CKDS record.
- NOCV-enablement keys are required for NOCV IMPORTERs and EXPORTERs. The NOCV-enablement system keys are used to twist on and twist off the CVs on external tokens during key import and key export. This allows ICSF to communicate with systems that do not use control vectors.
- ANSI system keys are required for almost all ANSI services to perform the notarization and offset that are required by ANSI X9.17.
- ESYS, or enhanced system keys, are used only in Symmetric Key Export service.

For information on system keys, see “Entering System Keys into the Cryptographic Key Data Set (CKDS)” on page 26.

You have to initialize a CKDS only the first time you start ICSF on a system. After you initialize a CKDS, you can copy the disk copy of the CKDS to create other CKDSs for use on the system. You can also use a CKDS on another ICSF system if the system has the same master key value. At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see “Refreshing the CKDS at Any Time” on page 117.

To define a master key and initialize a CKDS:

1. Enter a master key into the new master key register.

   For a description of how to use the Clear Master Key Entry panels to enter the master key, see “Entering the First Master Key Part” on page 97. For a description of how to use the TKE workstation to enter the master key, refer to the *OS/390 ICSF TKE Workstation User's Guide* or *OS/390 ICSF TKE Workstation User's Guide 2000*.

2. Initialize the CKDS.

   After you enter the master key into the new master key register, it remains inactive until you initialize the CKDS and set the master key.

   a. Return to the Primary Menu panel by pressing END from the Clear Master Key Entry panel.

   b. Select Option 6, CKDS, on the Primary Menu panel as shown in Figure 97.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 6

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
```

Figure 97. ICSF Selecting the CKDS Initialization Option on the Primary Menu Panel

The Initialize a CKDS panel appears. See Figure 98 on page 116.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 98. ICSF Initialize a CKDS Panel

c. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

   The name you enter should be the same name that is specified in the CKDSN installation option in the installation options data set. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see the *OS/390 ICSF System Programmer's Guide*.

d. Choose option 1, Initialize an empty CKDS, and press ENTER.

   ICSF creates the header record in the disk copy of the CKDS. Next, ICSF sets the DES master key. ICSF then adds the required system keys to the CKDS and refreshes the CKDS. When ICSF completes all these steps, the message `INITIALIZATION COMPLETE` appears. If you did not enter a master key into the new master key register previously, the message `NMK REGISTER NOT FULL` appears and the initialization process ends. You must enter a master key into the new master key register before you can initialize the CKDS.

   Note: If any part of the option 1 fails, you must delete the CKDS and start over. If the failure occurs after the master key has been set and before the system keys have been created, you will need to reset the master keys.

e. If you want ICSF to create NOCV-enablement keys after the initialization process has been completed, select option 2, NOCVKEYS, and press ENTER.

   The creation of NOCV-enablement keys is optional. It allows you to use either the key generator utility program or the Key Token Build callable service to create NOCV keys. NOCV keys allow you to send and receive keys from systems that do not use control vectors. For information on the uses of system keys, see “Entering System Keys into the Cryptographic Key Data Set (CKDS)” on page 26. For a description of NOCV keys, see the description of the NOCV keyword for the key generator utility program in 223.

   Note: If you want to run the ICSF conversion program to convert a CUSP/PCF CKDS into ICSF format, the CKDS you start ICSF with must contain NOCV-enablement keys. For more information about

the conversion program, see the *OS/390 ICSF System Programmer's Guide*.

f. To create ANSI system keys that are used for the ANSI X9.17 services, choose option 3, ANSI.

   The creation of ANSI system keys is optional. ANSI system keys are required if you intend to also create enhanced system keys.

   The message `ANSI KEYS ADDED` appears on the top right of the panel, if the process succeeds.

g. To create enhanced system keys, choose option 4, ESYS.

   The creation of enhanced system keys is optional. To create enhanced system keys, you must have previously installed the ANSI system keys in the CKDS.

   The message `ESYS KEYS ADDED` appears on the top right of the panel, if the process succeeds.

After you complete the entire process, a master key and CKDS exist on your system. You can now generate keys using the key generate callable service and key generator utility program, or convert CUSP/PCF keys to ICSF keys using the conversion program. You can also enter keys into the KSU by use of KGUP. ICSF services use the keys to perform the cryptographic functions you request.

Note: You enable special secure mode to initialize ICSF for the first time. After you perform the initialization process, you may choose to disable special secure mode.

Refreshing the CKDS at Any Time

After you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use KGUP to add and update any of the disk copies on your system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage CKDS. For information about using KGUP, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213. For information on using the dynamic CKDS callable services, refer to the *OS/390 ICSF Application Programmer's Guide*.

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS by following the steps below. You can refresh the CKDS at any time without disrupting cryptographic functions.

Note: Before you refresh a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

1. Enter option 6, CKDS, on the ICSF Primary Menu panel to access the Initialize a CKDS panel, which is shown in Figure 99 on page 118.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>  5


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'PIN1.CKDS'
```

Figure 99. Selecting the Refresh Option on the ICSF Initialize a CKDS Panel

2. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.
3. Choose option 5, REFRESH, and press ENTER.

   ICSF places the disk copy of the specified CKDS into storage. During a REFRESH, ICSF does not load into storage any partial keys that may exist when you enter keys manually. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.

   After ICSF reads the CKDS into storage, it performs a MAC verification on each record in the CKDS. If a record fails the MAC verification, ICSF sends a message that gives the key label and type to the OS/390 system security console. You can then use either KGUP or the dynamic CKDS update services to delete the record from the CKDS. Any other attempts to access a record that has failed MAC verification results in a return code and reason code that indicate that the MAC is not valid.
4. Press END to return to the Primary Menu panel.

Note: You can use either a KGUP panel or a utility program, instead of the CKDS panel, to refresh the CKDS. For information about these other methods, see "Refreshing the In-Storage CKDS" on page 247.

Reentering Master Keys After They have been Cleared

In the following situations, the Cryptographic Coprocessor Feature (CCF) clears the master key registers so that the master key values are not disclosed.

- If the Cryptographic Coprocessor Feature detects tampering.
- If you issue a command from the TKE workstation to zeroize a domain.
- If you issue a command from the Support Element panels to zeroize all domains.

In the following situations, the PCI Cryptographic Coprocessor Feature (PCICC) clears the master key registers so that the master key values are not disclosed.

- If the PCI Cryptographic Coprocessor Feature detects tampering (the intrusion latch is tripped), ALL installation data is cleared: master keys, retained keys for all domains, as well as roles and profiles.
- If the PCI Cryptographic Coprocessor Feature detects tampering (the secure boundary of the card is compromised), it self-destructs and can no longer be used.
- If you issue a command from the TKE workstation to zeroize a domain

  This command zeroizes the data specific to a domain: master keys and retained keys.
- If you issue a command from the Support Element panels to zeroize all domains.

  This command zeroizes ALL installation data: master keys, retained keys and access control roles and profiles.

Although the values of the master keys are cleared, the keys in the CKDS are still enciphered under the cleared DES master key. The RSA and DSS private key are also each enciphered under one of the cleared PKA master keys. Therefore, to recover the keys in the CKDS, and the PKA private keys, you must reenter the same master keys and activate the DES master key. For security reasons, you may then want to change all the master keys.

PR/SM Considerations: If you are running in PR/SM logical partition (LPAR) mode, there are several situations (listed previously) that can cause the loss of master keys and other data. In these cases, you must first ensure that key entry is enabled for each LP on the Change LPAR Cryptographic Controls page on the support element Hardware Master Console. You must then reenter the master keys in each LP. If you have a PCICC, you also need to regenerate retained keys. If you zeroize a domain using the TKE workstation, however, the master keys are cleared only in that domain. Master keys in other domains are not affected and do not need to be reentered. For more information about reentering master keys in LPAR mode, see Appendix C, “PR/SM Considerations during Key Entry” on page 331.

After the Cryptographic Coprocessor Feature clears the master keys, reenter the same master keys by following these steps:

1. Check the status of the PKA callable services. If they are enabled, use the User Control Functions to disable them. See “Enabling and Disabling PKA Services” on page 57 for details.
2. Retrieve the key parts, checksums, verification patterns, and hash patterns you used when you entered the master keys originally.

   These values should be stored in a secure place as specified in your enterprises security process.
3. Access the Clear Master Key Entry panels and enter the master keys as described in “Entering the First Master Key Part” on page 64.

   After you enter the DES master key, the Master Key Management panel appears. See Figure 100 on page 120.

   To activate the DES master key you just entered, you need to set it.
4. To set the DES master key, choose option 2 on the panel and press ENTER.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  2


Enter the number of the desired option above.

  1  ENTER  -  Enter a new master key to a KSU
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 100. Selecting the Set Host Master Key Option on the ICSF Master Key Management Panel

After you select option 2, ICSF checks that the states of the registers are correct. ICSF then transfers the DES master key from the new master key register to the master key register. This process sets the DES master key.

When ICSF attempts to set the DES master key, it displays a message on the top right of the Master Key Management panel. The message indicates either that the master key was successfully set, or that an error prevented the completion of the set process.

Notes:

a. If your system is using both crypto modules provided by a Cryptographic Coprocessor Feature, ICSF sets the DES master key for each crypto module whose new DES master key enciphers the in-storage CKDS. You should reenter the DES master key into the new master key register for each of the crypto modules.

b. The operator console receives messages that state that the crypto module is offline and then online for each crypto module. These actions should not affect cryptographic operations. However, if a crypto module does not have either a current DES master key or a new DES master key that enciphers the current in-storage CKDS, the crypto module is left offline.

When you set the reentered DES master key, the DES master key that enciphers the existing CKDS now exists.

5. You can now change the DES master key, if you choose to, for security reasons. Continue with “Changing Master Keys” on page 79.

Changing Master Keys

For security reasons your installation should change the master keys periodically. In addition, if the master keys have been cleared, you may also want to change the master keys after you reenter the cleared master keys.

There are three main steps involved in changing the DES master key:

1. Enter the DES master key and SYM-MK parts.
2. Reencipher the CKDS under the new DES master key.
3. Activate the new DES master key and SYM-MK.

The step-by-step procedure for changing the DES master key, reenciphering the CKDS, and activating the new DES master key are presented in “Changing the Master Key Using the Master Key Panels” on page 122. This section provides

some background on the contents of the master key registers during the key change process, and some compatibility mode considerations.

A DES master key and a CKDS that contains keys that are enciphered under that DES master key already exist. Before you replace this existing DES master key with the new DES master key, you must reencipher the CKDS under the new DES master key.

Note: Before you reencipher a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to "Disallowing Dynamic CKDS Updates During KGUP Updates" on page 214.

If you changed the DES master key before, the previous DES master key was stored in the auxiliary (or new/old) master key register. The currently active DES master key exists in the master key register. When you enter the key parts of a new DES master key, they displace the previous DES master key in the auxiliary master key register. Therefore, the previous DES master key is lost.

If you are using the Cryptographic Coprocessor Feature (CCF), to make the new DES master key the current active DES master key, you have ICSF swap the contents of the master key register and the auxiliary master key register. If you also have the PCICC, ICSF will change the PCI SYM-MKs. In this way, the new DES master key you have just entered becomes the current DES master key, and the previous DES master key is stored in the auxiliary master key register.

Before the new DES master key is placed into the master key register, you must reencipher all disk copies of the CKDS under the new DES master key. Then you are ready to activate the master key. When you change the master key, you have ICSF replace the in-storage copy of the CKDS with the reenciphered disk copy. This also makes the new master key active on the system.

The procedures you use to activate the new master key depend on your system's compatibility mode. ICSF runs in noncompatibility, compatibility, or co-existence mode with the IBM cryptographic products, Cryptographic Unit Support Program (CUSP) and Programmed Cryptographic Facility (PCF). You specify which mode ICSF runs in by using an installation option. For a description of the modes and how to specify an installation option, see the *OS/390 ICSF System Programmer's Guide*.

In noncompatibility mode, ICSF allows you to change the master key with continuous operations. Therefore applications can continue to run without disruption. However, when ICSF is in compatibility mode or co-existence mode, you should use a different procedure to activate the changed master key. This is to ensure that no application is holding an internal token with the wrong master key.

In all three modes, you enter the new master key and reencipher the disk copy of the CKDS under the new master key using the master key panels. In noncompatibility mode, you then activate the new master key and refresh the in-storage copy of the CKDS with the disk copy using the master key panels or a utility program.

In compatibility mode and coexistence mode, however, activating the new master key and refreshing the in-storage copy of the CKDS does not reencipher internal key tokens under the new master key. ICSF applications that are holding internal key tokens which have been enciphered under the wrong master key will fail with a

warning message. Applications that use the CUSP and PCF macros, run with no warning message and produce erroneous results.

If you are using the CCF, the safest method to use after changing the master key in either compatibility or coexistence mode is as follows:

1. Ensure that the name of the new CKDS is in the installation data set.
2. Re-IPL MVS.
3. Start CSF.

If you also have PCICC installed, after you start CSF, you must go to the Master Key Management panel (Figure 100 on page 120) and do a set (option 2). This will change the master keys of all the PCICC that match the CCF.

A re-IPL ensures that a program does not access a cryptographic service that uses a key that is encrypted under a different master key. If a program is using an operational key, the program should either re-create or reimport the key, or generate a new key.

If a re-IPL is not practical in your installation, you can use this alternative method. Stop all cryptographic applications, especially those using CUSP or PCF macros, before activating the new master key and refreshing the in-storage copy of the CKDS. This eliminates all operational keys that are encrypted under the current master key. After you start CSF again, applications using an operational key can either re-create or reimport the key.

Changing the Master Key Using the Master Key Panels

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering Clear Master Key Parts” on page 57.

   The new master key register must be full before you change the master key.

2. Select option 3, CHANGE, on the Master Key Management panel, as shown in Figure 101, and press ENTER.

   Note: If your system is using two cryptographic coprocessors, they must have the same master key. When you change the master key in one coprocessor, you should change the master key in the other coprocessor. Therefore, before you can reencipher a CKDS under a new master key, the new master key registers in both coprocessors must contain the same value.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  3


Enter the number of the desired option above.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 101. Selecting the Change Master Key Option on the ICSF Master Key Management Panel

The Change/Reencipher panel appears. See Figure 102 on page 123.

```
CSFCMM00 ----------------- OS/390 ICSF - Change/Reencipher ---------------
OPTION  ===>


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 102. Change/Reencipher Panel

Before you change the master key, you must first reencipher the disk copy of the CKDS under the new master key.

3. To reencipher a disk copy, choose option 1 on the Change/Reencipher panel.

   The Reencipher CKDS panel appears. See Figure 103.

```
CSFCMK10 ----------------- OS/390 ICSF - Reencipher CKDS ------------------
COMMAND ===>


To reencipher all CKDS entries from encryption under the current master key
to encryption under the new master key enter the CKDS names below.


   Input CKDS ===> CKDS.CURRENT.MASTER

   Output CKDS ===> CKDS.NEW.MASTER
```

Figure 103. Reencipher CKDS

4. In the Input CKDS field, enter the name of the CKDS that you want to reencipher. In the Output CKDS field, enter the name of the data set in which you want to place the reenciphered keys.

   Note: The output data set should already exist although it must be empty. For more information about defining a CKDS, see the *OS/390 ICSF System Programmer's Guide*.

   Reenciphering the disk copy of the CKDS does not affect the in-storage copy of the CKDS. On this panel, you are working with only a disk copy of the CKDS.

5. Press ENTER to reencipher the input CKDS entries and place them into the output CKDS.

   The message REENCIPHER SUCCESSFUL appears on the top right of the panel if the reencipher succeeds.

6. If you have more than one CKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the CKDS, you are ready to change the master key.

7. Press END to return to the Change/Reencipher panel.

   Changing the master key involves refreshing the in-storage copy of the CKDS with a disk copy and activating the new master key.

8. If you are running in compatibility or co-existence mode, *do not* select option 2, the Change option. To activate the changed master key when running in compatibility or co-existence mode, you need to re-IPL MVS and start ICSF. When you re-IPL MVS and start ICSF, you activate the changed master key and refresh the in-storage CKDS. To do this, you must exit the panels at this time.
9. If you are running in noncompatibility mode, to change the master key select option 2 on the Change/Reencipher panel, as shown in Figure 104.

```
CSFCMM00 ----------------- OS/390 ICSF - Change/Reencipher ----------------
OPTION  ===> 2


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 104. Selecting the Change Master Key Option on the Change/Reencipher Panel

When you press the ENTER key, the Change Master Key panel appears. See Figure 105.

```
CSFCMK20 --------------------- OS/390 ICSF Change Master Key --------------
COMMAND ===>


Enter the name of the new CKDS below:

  New CKDS ===> CKDS.NEW.MASTER

When the master key is changed, the new CKDS will become active.
```

Figure 105. Change Master Key Panel

10. In the New CKDS field, enter the name of the disk copy of the CKDS that you ICSF to place in storage.

    You should have already reenciphered the disk copy of the CKDS under the new master key. The last CKDS name that you specified in the Output CKDS field on the Reencipher CKDS panel, which is shown in Figure 56 on page 82, automatically appears in this field.
11. Press ENTER.

    ICSF loads the data set into storage where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

    After you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that prevented the successful completion of the change process. For example, if you indicate a data set that is not reenciphered under the new master key, an error message displays, and the master key is not changed.

Note: Each Cryptographic Coprocessor Feature includes two crypto modules, which ICSF recognizes as C0 and C1. You must enter the new master key into each of the coprocessors, before you perform the change. ICSF activates the new master key of both coprocessors that contain a new master key value that will encipher the CKDS.

If only one coprocessor new master key value matches the new CKDS, then that coprocessor will be used. The other coprocessor will remain offline until the new master key is changed to match the other coprocessor.

When the change occurs, the operator console receives messages that state that the Cryptographic Coprocessor Feature is off line and then online for each coprocessor. These actions should not affect cryptographic operations.

You can use a utility program to reencipher the CKDSs and change the master key instead of using the panels. "Reenciphering a Disk Copy of a CKDS and Changing the Master Key" on page 317 describes how to use the utility program for these procedures.

Changing the PKA Master Keys

Attention: Changing the PKA master keys will make all internal tokens in the current PKDS unusable. You will need to recreate the internal tokens in order to use them with the changed master key.

If you CANNOT recreate the tokens, we suggest that you DO NOT change the PKA master keys.

When the PKDS is shared by multiple images in a sysplex environment, the PKA master key must also be changed on all the sharing systems.

To change the PKA master keys:

1. Access the user control functions by selecting option 7, USERCNTL, on the primary menu panel as shown in Figure 106.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 106. Selecting the User Control Functions on the ICSF Primary Menu Panel

The User Control Function panel appears. See Figure 107 on page 126.

```
CSFUFN00 ------------- OS/390 ICSF - User Control Functions
OPTION ===>

Enter the number of the desired option.

  Dynamic CKDS Access

  1  ALLOW       -  Allow Dynamic CKDS access
  2  DISALLOW    -  Disallow Dynamic CKDS access

  PKA Callable Services

  3  ENABLE      -  Enable PKA callable services
  4  DISABLE     -  Disable PKA callable services
```

Figure 107. Enabling and Disabling the PKA Callable Services

2. Disable the PKA callable services, by selecting option 4 and pressing enter.

   The primary menu panel appears when PF3 is pressed on the USERCNTL panel.

3. Select option 1, MASTER KEY, and press enter.

   The first Master Key Management panel appears.

4. Select option 1, ENTER.

   Another Master Key Management panel appears.

5. Select option 1, Cryptographic Coprocessor Feature Clear Master Key Entry.

   The Coprocessor Selection panel appears.

6. Select the coprocessor for PKA master key entry by typing the coprocessor number on the OPTION line and pressing enter.

   The Clear Master Key Entry panel appears. See Figure 108.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key    : C0
               New master key register status             : EMPTY
               PKA Key Management Master Key register     : FULL
               PKA Signature Master Key register          : FULL

 Specify information below
   Key Type  KMMK             (NMK, KMMK, SMK)

   Part      RESET_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (KMMK, SMK only)
```

Figure 108. The Clear Master Key Entry Panel to Reset Registers

   You need to RESET to clear the contents of the registers before you can set a new key value.

7. When you select RESET, the Restart Key Entry Process panel is displayed. See Figure 109 on page 127.

   This panel confirms your request to restart the key entry process. Press ENTER.

```
CSFDKE40 -------------- OS/390 ICSF - Restart Key Entry Process -------------

ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?

  Restarting the process will clear the KMMK   key register.

 WARNING:  Resetting the KMMK or SMK will invalidate any private
internal key tokens in the PKDS

Press ENTER to confirm restart request
Press END   to  cancel restart request
```

Figure 109. Confirm Restart Request Panel

8. The Clear Master Key Entry panel again appears. See Figure 110. Enter the type of PKA master key you are changing and enter the key part.

```
CSFDKE10 -------------- OS/390 ICSF - Clear Master Key Entry ---------
COMMAND ===>
               Coprocessor selected for new master key    : C0
               New master key register status             : EMPTY
               PKA Key Management Master Key register     : EMPTY
               PKA Signature Master Key register          : FULL

 Specify information below
   Key Type  KMMK             (NMK, KMMK, SMK)

   Part      FINAL_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 59

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 9B28AEFA8C47760F   (KMMK, SMK only)
```

Figure 110. The Clear Master Key Entry Panel with Final Key Values

   In this example, we are entering a KMMK and have entered FINAL for the key part since a PKA master key requires only one key part. You may enter additional key parts if necessary. However, if you are entering asymmetric-keys master key (ASYM-MK), you are required to enter a FIRST and a FINAL part.

9. Type the key part value and the checksum.

   If you used the random number generator utility to generate the key part values just before starting the PKA master key change process, the key part values are transferred directly to this panel. This eliminates the need to retype these values.

10. When all the fields are complete, press ENTER.

If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`. The PKA key management master key register status changes to `FULL`. The hash pattern that is calculated for the key part appears near the bottom of the panel.

11. *Record the hash pattern.* Compare it with the pattern generated by the random number generator or provided by the person who gave you the key part value to enter.
12. After you have changed the PKA master keys, go to the User Control Function panel and enable PKA callable services. Also enable PKDSRead and PKDSWrite.

Note: If your system has two crypto's, you must repeat the PKA key entry process for the remaining crypto. You must enter the same key value on both crypto units. PKA callable services CANNOT be enabled if the keys on both cryptos do not match. Also, PCICCs cannot be marked available for use until the master keys match the CCF SMK.

Clearing Master Keys

For security reasons, your installation may need to clear the master keys. This may be required, for example, before turning the processor hardware over for maintenance.

If you have a TKE workstation, you can use it to zeroize all domains that have keys loaded. Refer to *OS/390 ICSF TKE Workstation User's Guide* and *OS/390 ICSF TKE Workstation User's Guide 2000* for more information.

If you do not have a TKE workstation, you might want to consider nullifying the master keys. To do this you would need to enter a new DES master key (perhaps all zeros), reencipher a dummy CKDS, and change the master key. You would need to perform this operation twice to ensure that the master key is cleared from the auxiliary (old) master key register. You would also need to reset both of the PKA master keys and process the PCICC master keys.

You can also use the zeroize function on the Support Element panel. Besides clearing the master keys, this also clears all domains and user data.

Adding PCICC After CCF Initialization

To initialize PCI Cryptographic Coprocessors after system initialization, follow the following procedure.

1. Select option 1, MASTER KEY, on the Primary Menu panel.
2. Select option 1, ENTER, on the Master Key Management panel, as shown in Figure 111 on page 129.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a coprocessor
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 111. Selecting the Enter Option on the Master Key Management Panel

3. The Master Key Management panel appears, as in Figure 112. Enter 3, PCI Cryptographic Coprocessor Feature Clear Master Key Entry and press ENTER.

```
CSFMKM20------------- OS/390 ICSF - Master Key Management -----------------
 OPTION ===> 3


 Enter the number of the desired selection.

   1  Cryptographic Coprocessor Feature Clear Master Key Entry - Enter
      the DES and PKA master keys via panels.

   2  Trusted Key Entry - Complete loading of DES new master key register
      from the key part registers queued from the TKE workstation.

   3  PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys for one coprocessor via panels.

   4  All PCI Cryptographic Coprocessor Clear Master Key Entry - Enter the
      master keys on all online coprocessors via panels

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 112. Selecting the CCF Clear Master Key Entry Option on the Master Key Management Panel

4. Select the coprocessor for master key entry by typing the coprocessor number on the OPTION line and pressing ENTER. For this example, coprocessor P03 is being added.

```
 CSFMKP02 -------------- OS/390 ICSF - PCICC Selection ------------
 OPTION ===> 4

   1. P00
   2. P01
   3. P02
   4. P03


Enter the number of one or two coprocessors to see the status of
specific coprocessor. Separate the numbers with a comma or a blank.

Press ENTER to see the status of all active coprocessors.

Press END   to exit to previous menu.
```

Figure 113. Coprocessor Selection Panel

5. The PCICC Clear Master Key Entry panel appears. See Figure 114 on page 130.

```
CSFDKE11 -------- OS/390 ICSF - PCICC Clear Master Key Entry ------
COMMAND ===>
                  Coprocessor selected for master key entry     : P03
                  Symmetric-keys New master key register status : EMPTY
                  Asymmetric-keys New Master Key register status: EMPTY

 Specify information below
   Key Type  ____             (SYM-MK, ASYM-MK)

   Part      ______           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (ASYM-MK only)



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 114. The PCI Clear Master Key Entry Panel to Reset Registers

Ensure that the new SYM-MK and the new ASYM-MK status fields indicate EMPTY. If they do not, you will need to RESET to clear the contents of the registers before you can set a new key value.

6. You must now load the SYM-MK and ASYM-MK keys into your system.

   If you are going to reload your current master keys, you need to know the current master key value and checksum. Then, follow the instructions on "Entering the First Master Key Part" on page 97.

7. Repeat this process for each new PCICC that you want to initialize.
8. After all key parts have been loaded, SET the master key. From the Primary Menu panel choose option 1 - Master Key. From the Master Key Management panel, choose option 2 - SET.

Chapter 7. Managing the Master Key and Operational Keys on the ES/9000-9021 (Bipolar) Processor

On the ES/9000-9021 (bipolar) processor with an ICRF, you can use the ICSF panels and the key entry hardware to enter DES master keys. You can also use the ICSF panels and the key entry hardware to enter some operational keys (transport keys and PIN keys) directly into the disk copy of the CKDS. Depending on the version of ICRF installed on your processor, you can enter keys either by using a Personal Security card, or manually. Your manual key entry hardware may be either the keypad or the key-entry unit (KEU). To determine which version of ICRF you are using, refer to “Using the KSU” on page 139.

This chapter includes a general description of how to use the ICSF panels, the KSU, and Personal Security cards to perform these tasks. It includes illustrations of the KSU front panels. Information about generating key parts for manual entry follows this. This chapter then includes sections about the different methods of entering the master key and operational keys. It also describes how to activate the master key, reenter the same master key, and enter a new master key to change the current master key.

Before You Begin Entering the Master Key

Before you define a master key and initialize a CKDS for the first time, you must initialize ICSF by following these steps:

1. Install the ICSF program product according to the instructions in the *ICSF Program Directory*.
2. In the PR/SM LPSEC frame, enable the following parameters to the partition:
   - ENA (enables crypto)
   - CDX (assigns the same domain as in ICSF options data set)
   - KSU 0, 1, or both
   - KE (key entry)
   - SPC (special secure mode)
3. Create an empty CKDS and initialize ICSF as described in the *OS/390 ICSF System Programmer's Guide*.
4. Create an installation options data set.

   When you initialize ICSF for the first time, you must activate special secure mode and noncompatibility mode. You activate the modes by specifying values in the installation options data set. To activate special secure mode, you must also place the mode switch on the KSU into the **Special Secure Mode** position.

   If your system has two KSUs, one of the following conditions must exist:
   - The mode switches on both KSUs are in the Special Secure Mode position.
   - The mode switch on one of the KSUs is in the Special Secure Mode position, and the mode switch on the other KSU is in the Standby position.
5. Create an ICSF startup procedure.

6. Start ICSF.
7. Access the ICSF panels. After you start ICSF, you use the ICSF panels to define a master key and initialize a CKDS.

Overview of Key Entry

To enter the DES master key and operational keys, you use the ICSF panels to select key entry options, track status, and observe verification patterns. At the same time, you use physical keys, called *brass keys*, to turn key switches on the ICRF KSU. You need to access both the ICSF panels and the ICRF at the same time, and coordinate master key entry tasks between them. For this reason, you may find it helpful to have the ICSF display terminal near the ICRF. An alternative is to provide a means for the ICSF administrator at the panels and the security officer at the ICRF to communicate with each other.

When you enter a key, you enter it in key parts. A key part is a 32-hexadecimal-digit value that is combined with other key parts to create the key. At minimum, you must enter a first and a final key part for a key. You can also enter as many middle key parts as you want.

Note: Because the key entry hardware is designed for the entry of double-length keys, it is not possible to enter single-length keys. Use the key generator utility program (KGUP) to enter single-length keys such as data encryption and translation keys or MAC generation and verification keys. See Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213.

When you enter a key part manually, you also enter a checksum. A checksum is a two-digit result of putting a key part through a series of calculations. After you enter a key part and a checksum, you can enter an optional verification pattern to check that you have entered the key correctly. If you are using a Personal Security card to enter a key part, the KSU reads the verification pattern directly from data blocks on the card. Before you begin to enter a key manually, you should have the values of the key parts, the checksums, and the optional verification patterns. For information about generating these values, see “Generating Key Part Data for Manual Key Entry” on page 145. This section describes the ICSF panels and how to choose options to perform the tasks involved in entering key parts. This section also describes the two styles of KSUs, the Personal Security card, and the KEU as they relate to key entry. If you are not familiar with using the ICSF panels or the ICRF, read the next sections on key entry before you begin entering either the master key or any operational keys. For more information about the ICRF, see the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide*. If you understand how to use the ICSF panels and the ICRF, you may skip the rest of this section. Go directly to the step-by-step instructions for entering a master key or operational keys with the ICRF hardware on your bipolar processor.

- To enter the master key with a Personal Security card, go to “A Description of the Front Panel of the ICRF with Keypad and Personal Security Card Reader” on page 140.
- To enter the master key manually, go to “Generating Key Part Data for Manual Key Entry” on page 145.
- To enter operational keys, go to “Entering Operational Keys” on page 186.

Using the ICSF Panels

When you access the Integrated Cryptographic Service Facility panels, the primary menu panel appears. See Figure 115.

```
CSF@PRIM ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 115. Selecting the Master Key Option on the ICSF Primary Menu Panel

To choose an option from this panel, type the number of the option, and press ENTER. For instance, if you enter 1, the master key option, you access the Master Key Management panel shown in Figure 116. From this panel you can get to a series of panels to enter, set, or change the master key. The master key panels prompt you to enter information on the panels, turn switches on the KSU, and enter the master key parts.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a KSU
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key









Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 116. ICSF Master Key Management Panel

You can perform the following master key management tasks from this panel:

- Define a master key for the first time.
- Reenter and activate a master key that was cleared.
- Change the master key by reentering and activating a new master key.

To begin any of these tasks, you choose option 1, ENTER. For example:

- **To define a master key for the first time:**
  1. Select option 1, ENTER, to access the panels to enter the master key.
  2. When you have entered the master key parts, leave the master key panels **without selecting the SET or CHANGE option**.
  3. Choose the CKDS option on the Integrated Cryptographic Service Facility panel, which is shown in Figure 115 on page 133, to enter the CKDS panel.
  4. On the CKDS panel, choose options to initialize the CKDS and activate the master key.
- **To reenter the same master key:**
  1. Select option 1, ENTER, to access the panels to enter the master key.
  2. When you have entered the master key, return to the Master Key Management panel.
  3. Select option 2, SET, to activate the master key.
- **To change a master key:**
  1. Select option 1, ENTER, to access panels to enter a new master key.
  2. When you have entered the master key, return to the Master Key Management panel.
  3. Select option 3, CHANGE, to reencipher the keys in the existing CKDS under the new master key and to activate the new master key.

Using the KSU Selection Panel

When you select the ENTER option on the Master Key Management panel, you access the KSU Selection panel as shown in Figure 117 on page 135.

```
CSFMKP10 -------------------- OS/390 ICSF - KSU Selection -----------------
OPTION ===>

                                                              CRYPTO DOMAIN: 0

Enter the number of the KSU to be used for key part input.

KSU/REGISTER STATUS        0. KSU 0               1. KSU 1

  Crypto CPs installed      : 0                    : 3
  Crypto CPs active         : 0                    : 3
  Physical switch position  : NORMAL               : NORMAL
  Key Part register         : DISABLED AND EMPTY   : DISABLED AND EMPTY
  New Master Key register   : EMPTY                : EMPTY
  NMK verification pattern  :                      :
  Old Master Key register   : EMPTY                : EMPTY
  OMK verification pattern  :                      :
  Master Key register       : VALID                : VALID
  MK verification pattern   : 1294ABCD5678EF91     : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED             : DISABLED

Press ENTER to select KSU and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 117. KSU Selection Panel

On this panel, you can perform the following tasks:

- Select the KSU for master key entry by typing the number and pressing ENTER.

  You can work on only one KSU at a time. On this panel, you specify the KSU on which you want to enter the master key.

- Show the current KSU status by pressing ENTER without selecting a KSU.

  The panel reflects any changes in the KSU status that have occurred since you accessed the panel.

Some processor models permit you to partition the processor unit into two sides, side 0, and side 1. The individual central processors, the processor storage arrays, and the channel subsystems are associated with side 0 or side 1. Such a processor is called a *multiprocessor model* and may have up to two KSUs. If it has two units, one is attached to each side. The KSU on Side 0 is called *KSU 0*, and the one on Side 1 is called *KSU 1*.

Your system may have one or two KSUs. If you have one KSU installed, this panel shows only the status for that unit. The fields for the second KSU are blank. If your system has two KSUs, the master keys that are stored in their respective master key registers must be the same. This panel gives you status information about each KSU. For example, you can check that the verification patterns match for each unit. If not, the master keys on each unit do not match, and you must enter a new master key on one of the units.

The KSU key-entry related status parameters that are defined on this panel are discussed below. For more information on all the parameters on these panels, refer to Figure 262 on page 298.

Physical switch position

This field shows the current operator key switch position on the KSU.

The possible positions of the key switches are:

- Normal
- Enter KP1
- Enter KP2
- Enter NMK(1)
- Enter NMK(2)

Unless you are performing key entry, the operator key switches should be in the Normal position. To insert and take out a brass key, a key switch must be in the Normal position. You use a specific brass key to enable entry of the first and last key parts. Brass key #1 can move the key switch to the Enter NMK(1), Enter KP1, or Normal position. Brass key #2 can move the key switch to the Enter NMK(2), Enter KP2, or Normal position. The physical key switches should be in the Normal position during normal operations.

Key Part register

This field shows the states of the key part register in the KSU.

You can put the key part register in any of the following states:

State	Indication
ENABLED and EMPTY	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position. You are accessing the correct ICSF panel, but have not yet entered the actual key part.
ENABLED and FULL	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position. You are entering a key part into the key part register but have not completed the panel path to move the key part into the new master register.
DISABLED and EMPTY	You have accessed the complete path of panels to enter a key part, and transferred the key part to the master key register. You have also returned the key switch to the Normal position.

New Master Key register

This field shows the states of the new master key register.

You can put the new master key register in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

The new master key register is actually the auxiliary master key register. The auxiliary master key register can contain either the new master key or the old master key. Therefore a new master key and an old master key cannot coexist

at the same time. If an old master key exists, it is lost when you enter a new one. Therefore, you should convert all your keys from under the old master key to under the current master key before you enter a new master key.

NMK verification pattern
If your system is using two KSUs, you must enter the same master key into both of them. If the new master key registers contain the same new master key value, the NMK verification patterns for the two sides should match.

Old Master Key register
This field shows the states of the old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

The old master key register is actually the auxiliary master key register. The auxiliary master key register can contain either the new master key or the old master key. Therefore a new master key and an old master key cannot coexist at the same time. If an old master key exists, it is lost when you enter a new one. Therefore, you should convert all your keys from under the old master key to under the current master key before you enter a new master key.

Master Key register
This field shows the states of the master key register.

State	Indication
EMPTY	You have never entered and set an initial master key on this KSU.
VALID	You have entered a new master key on this KSU and chosen either the set or change option.

Using the Enter New Master Key Panels

After you choose a KSU on the KSU Selection panel, the Enter New Master Key panel appears. See Figure 118 on page 138.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 1


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register




Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 118. Selecting the Enter Key Part Option on the Enter New Master Key Panel

This is the first panel in a series of master key entry panels that guide you through and track the status of the master key entry process.

When you enter the master key, you enter the first key part, any optional intermediate key parts, and the final key part. After you enter the first key part, you return to this panel to enter any intermediate key parts and the final key part. While you are entering a key part, if you realize that you entered a key part incorrectly, you can restart the key entry process. For information on how to restart the key entry process, see “Restarting the Key Entry Process” on page 175.

On this panel, you can perform the following tasks:

- Type 1 and press ENTER to enter either the first key part, or any intermediate key part.
- Type 2 and press ENTER to enter the final key part.
- Type 3 and press ENTER to restart the key entry process.

All the panels for entering key parts show status information at the top.

KSU selected for new master key
This field displays the KSU you selected for master key entry.

The number can be either 0 or 1.

Current physical switch position
This field displays the current position of the key switches on the KSU. To access certain panels, the operator key switches must be in the appropriate position.

The possible positions of the key switches are:

- Normal
- Enter NMK(1)
- Enter NMK(2)

Key part register status
This field shows the status of the key part register in the KSU.

State	Indication
ENABLED and EMPTY	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position,. You are accessing the correct ICSF panel, but have not yet entered the actual key part.
ENABLED and FULL	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position. You are entering a key part into the key part register, but have not completed the panel path to move the key part into the new master register.
DISABLED and EMPTY	You have accessed the complete path of panels to enter a key part, and transferred the key part to the master key register. You have returned the key switch to the Normal position.

New master key register status
This field shows the status of the new master key register.

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register.
PART-FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

The other key entry panels are similar to the Enter New Master Key panel in Figure 118 on page 138. The instructions for the key entry process appear in the bottom half of the panel as you progress through the master key entry process. The other panels are shown in the step-by-step master key entry sections later in this chapter.

Using the KSU

ICSF ensures that only authorized personnel can perform master key procedures. A security officer uses physical keys, that are called brass keys, to turn switches on the KSU to enter master key parts.

To enter the master key, you work with both the KSU and a terminal that displays the panels. For greater security, you can have a different security officer perform the tasks at the KSU and the tasks at the terminal. For additional security you can have a different security office responsible for entering a different key part of the master key.

There are two different versions of the ICRF on the bipolar processor. The steps you take to enter the master key depend on which version is installed on your processor. To determine which version you have, refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide*. Depending on the version of ICRF you are using, you enter a master key in one of the following ways:

- Inserting Personal Security cards into the card reader on the KSU
- Using the keypad on the KSU to manually enter master key parts
- Using the key-entry unit (KEU) that is attached to the KSU to manually enter master key parts

A Discussion of Master Key and Key Part Registers

The values you enter are stored in registers inside the KSU. As you perform the master key management tasks, the values are moved to the appropriate registers.

The KSU contains the following registers:

- Key part register
- Auxiliary master key register
- Master key register

The auxiliary master key register contains either the new or old master key. Panels display the status of these registers when you need to know this information to perform master key procedures.

The key part register stores a master key part while you enter it. After you enter the entire key part, ICSF moves it into the auxiliary master key register. The auxiliary master key register is now referred to as the new master key register because it contains key parts for the new master key. As the rest of the master key parts are entered, ICSF exclusive ORs them with the other master key parts in the new master key register. A master key in the new master key register is not active. You need to use the panels to transfer the new master key into the master key register. The master key stored in the master key register is active and is used to encipher keys in the CKDS.

When you change a master key, the master key that is replaced by the new master key is stored in the auxiliary master key register. The auxiliary master key register is now referred to as the old master key register because it contains the old master key. ICSF uses the old master key if it has to reencipher a key from under the old master key to under the current master key.

The auxiliary master key register contains either a new master key or an old one. Therefore, a value for a new master key and an old master key cannot exist at the same time. When you change a master key, you must enter a new master key value into the auxiliary master key register. When you activate a new master key, ICSF transfers the new master key from the auxiliary master key register into the master key register and transfers the previous master key into the auxiliary master key register.

A Description of the Front Panel of the ICRF with Keypad and Personal Security Card Reader

The front panel of the KSU on the ICRF with keypad and Personal Security card reader is shown in Figure 119 on page 141.

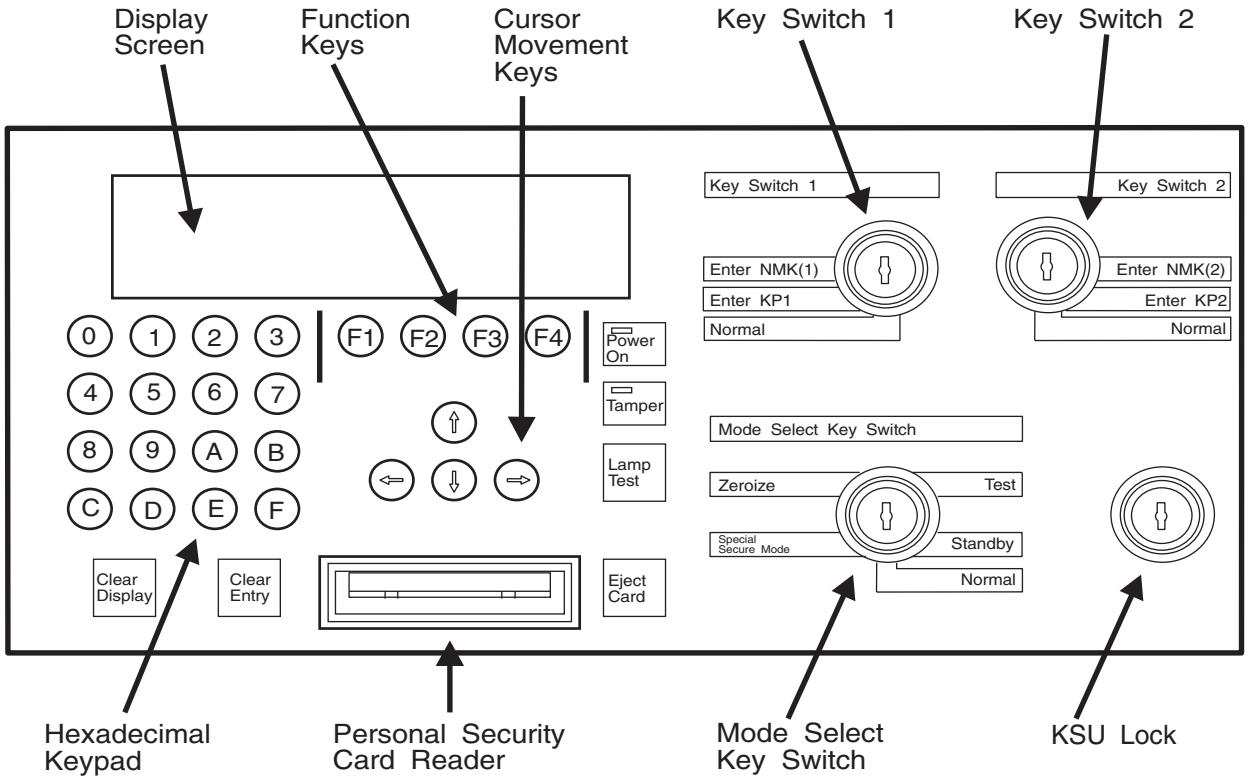

Figure 119. Key Storage Unit (KSU) on the ICRF with Keypad and Personal Security Card Reader

The parts of KSU front panel support three main tasks.

- Enabling key part entry
- Entering key parts with a Personal Security card
- Entering key parts manually

This section describes each part as it relates to these tasks.

- **Enabling key part entry**

  The mode selection and key switches on the right side of the KSU front panel prepare the ICRF to receive key parts. The key parts may be entered either manually or by using a Personal Security card.

Switch	Function
Mode Select Key Switch	To begin entering key parts, you must use a brass key to place the mode switch into the Normal or Special Secure Mode position. To insert or remove the brass key, the mode select key switch must be in the Normal position.
Key Switch 1	Before you can enter the first master key part, use brass key #1 to turn Key Switch 1 to the Enter NMK(1) position.
Key Switch 2	Before you can enter any intermediate master key parts or the final master key part, use brass key #2 to turn Key Switch 2 to the Enter NMK(2) position.

You should enable special secure mode only when performing the following tasks:

- Using the key generator utility program to enter clear keys
- Using the secure key import callable service to enter clear keys
- Producing clear PINs
- Initializing the CKDS

When the mode switch is in the **Special Secure Mode** position, the KSU alphanumeric display will display `SSEC`.

For additional security, your installation can give one security officer one brass key and another security officer the other brass key. Each officer can then enable entry of only one part of the master key.

- **Entering key parts with a Personal Security card**

  The parts that you use to enter key parts from a Personal Security card are located in the center of the KSU front panel.

Part	Function
Personal Security card reader	Each master key part is stored in a data block on a separate Personal Security card. You insert the Personal Security card into the card reader with the logo-side up and with the gold contacts first.
Cursor movement keys	Use the cursor movement keys to select the correct data block from among those that are displayed on the screen. The KSU reads the data blocks from the Personal Security card that is inserted into the card reader.
Function keys	The function of each of these keys varies depending on the menu on the display screen.
Display screen	During the key entry process, messages appear on the four-line alphanumeric display above the keypad. Messages and dialog appear in the left side of the display screen. The Operator key switch position and the function key definitions appear on the right side of the display.

- **Entering key parts manually**

  Use the left side of the KSU front panel and the display screen for manual key part entry.

Part	Function
Keypad	The keypad consists of data keys 0 through F and allows you to enter key parts manually.
Clear key	Pressing the Clear key clears all entries on the screen. *After you press the Clear key, you should always press the Clear Entry key.*
Clear Entry key	Pressing the Clear Entry key erases the last digit you entered.

Using Personal Security Cards to Distribute and Enter Master Key Parts:
Master key part data can be stored on Personal Security cards for distribution and easier installation. Each master key part is stored in a data block on a separate Personal Security card. The data that is associated with each key part includes:

- A 16-byte key part
- A 16-byte block of descriptive text
- An eight-byte verification pattern

Use a 4754 Security Interface Unit attached to a PC to generate master key part data and store it on the Personal Security card. For more information about programming Personal Security cards, refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide*.

You can program Personal Security cards at a central location and dispatch them by courier to the ICRF location. For additional security, you can entrust each Personal Security card containing a separate key part to a separate courier.

For actual step-by-step instructions for using Personal Security cards to enter the master key, refer to "Entering Master Key Parts with Personal Security Cards" on page 151.

Using the Keypad to Enter Master Key Parts: The keypad on the KSU allows you to enter master key parts manually. Each key part consists of a 16-digit left half and a 16-digit right half. The left half key (LHK) and right half key (RHK) input areas appear on the display screen. As you enter each digit of the key part half, an asterisk (*) appears on the display screen.

After you enter both the LHK and the RHK for a key part, the cursor moves to the Checksum (CkSum) input area on the display screen. Enter the two-digit checksum value here. The checksum verifies that you entered a key part correctly without accidentally transposing the digits or pressing the wrong digit on the keypad. Each time you enter a key part, the ICRF calculates the checksum for it. If the checksum you enter and the checksum the ICRF calculates are the same, the key part is valid.

For additional security, your installation can give each security officer one key part and the brass key that enables its entry. Each officer is then responsible for and able to enter only one part of the master key.

If you intend to enter keys manually at the keypad, you need to generate the key parts, the checksums, and the optional verification patterns. Refer to "Generating Key Part Data for Manual Key Entry" on page 145. If you have already generated the key part data, continue with "Entering Master Key Parts Manually" on page 161.

A Description of the ICRF with Hand-Held Key-Entry Unit

The front panel of the KSU on the ICRF with hand-held key-entry unit is shown in Figure 120 on page 144.

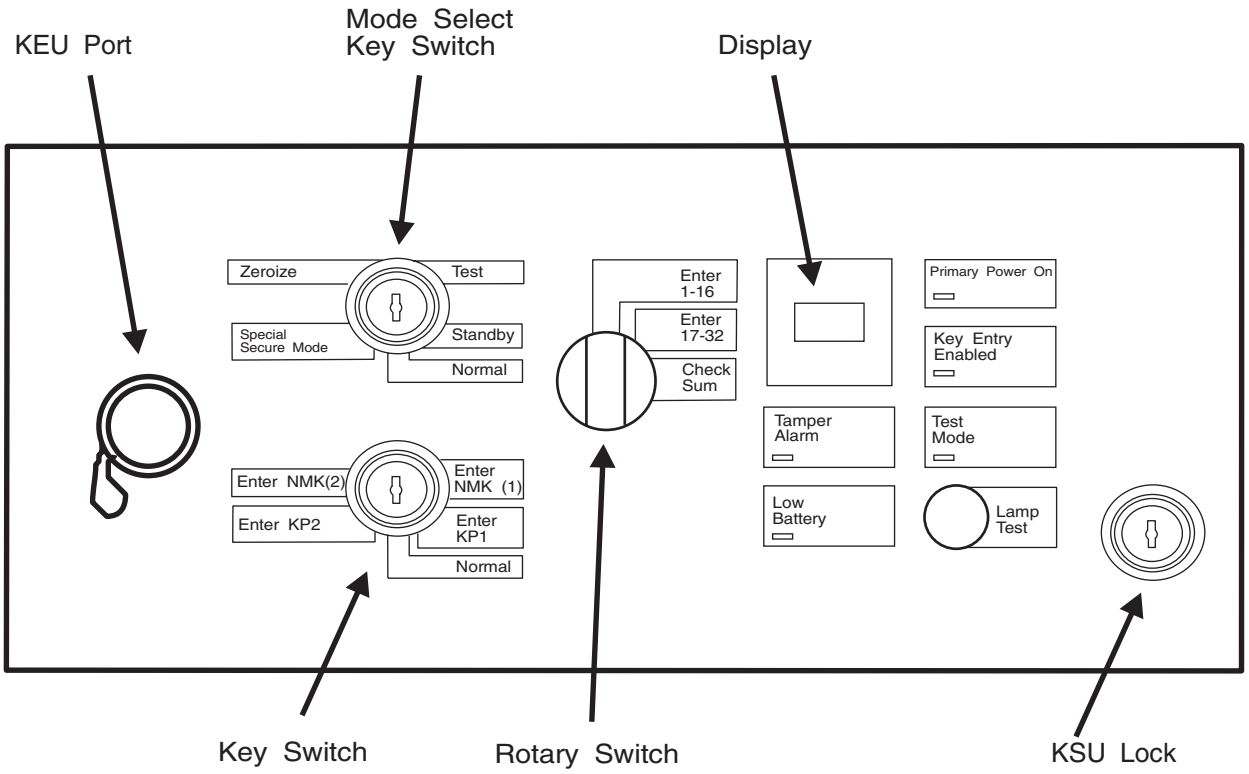

Figure 120. Key Storage Unit (KSU) on the ICRF with Hand-Held Key-Entry Unit

This section describes the parts of KSU front panel as they relate to key entry.

Part	Function
Mode select key switch	To begin entering key parts, you must use a brass key to place the mode switch into the Normal or Special Secure Mode position. To insert or remove the brass key, the mode select key switch must be in the Normal position.
Key switch	Before you can enter the first master key part, use brass key #1 to turn the key switch to the Enter NMK(1) position. Before you can enter any intermediate master key parts or the final master key part, use brass key #2 to turn the key switch to the Enter NMK(2) position.
Rotary switch	Use the rotary switch specify whether you are entering the first half of a key part, the second half of a key part, or a checksum.
Display	During the key entry process, messages appear on a 4-digit alphanumeric display on the KSU.
KEU Port	Plug the hand-held KEU into this port to enable the manual entry of key parts.

Use the key-entry unit (KEU), a hand-held hexadecimal key pad that plugs into the KSU, to enter key parts into the KSU. Figure 121 shows the KEU.

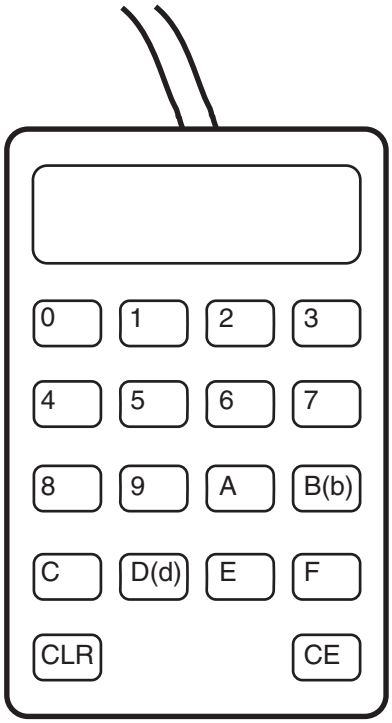

Figure 121. Key-Entry Unit (KEU)

The parts of the KEU include:

Part	Function
Hexadecimal keypad	Use data keys 0 through F to enter each 16-digit key part half.
Hexadecimal readout screen	As you enter each digit of the key part half, an asterisk (*) appears on the readout screen.
CLR key	The clear key erases the whole screen.
CE key	The clear entry key erases the last digit entered.

Before you can use the KEU to enter a master key, you must generate the key parts, checksums, and optional verification patterns. Continue with Generating Key Part Data for Manual Key Entry.

If you have already generated the key part data, continue with “Entering Master Key Parts Manually” on page 161.

Generating Key Part Data for Manual Key Entry

If you intend to enter either a master key or an operational key manually, you need to generate and record the following values before you begin:

- Key parts
- Checksums
- Verification patterns (optional)

If you are reentering a master key after it was cleared, use the same master key part values as when you originally entered the key.

To enter a DES key, you must enter two or more key parts. A DES key is 16 bytes long. ICSF creates a key by exclusive ORing two or more key parts. Each of the key parts is also 16 bytes long. You must enter a first key part and a final key part. If you choose to, you can also enter one or more intermediate key parts. You enter an intermediate key part after the first key part and before the final key part. If you are using ICSF to generate random numbers, generate a random number for each key part that you need to enter to create the master key or operational key.

You must enter 32 hexadecimal digits to enter a key part. To make this process easier, each part is broken into halves of 16 digits each. When you are manually entering the key parts, you also enter a checksum that verifies whether you entered the key part correctly. A checksum is a two-digit result of putting a key part value through a series of calculations. The ICRF calculates the checksum with the key part you enter and compares the one it calculated with the one you entered. The checksum verifies that you did not transpose two digits when entering the key part. If the checksums are equal, you have successfully entered the key part.

After you enter a key part and its checksum, the ICRF calculates an eight-byte verification pattern and displays it on the ICSF panel. If you generate an optional verification pattern at the same time that you generate the key part and the checksum, you can check this displayed verification pattern against it. The verification pattern checks whether you entered the key part correctly, and whether you entered the correct key type. Not only does ICSF display a verification pattern for each key part, but it also displays a verification pattern for the final key after you enter all the key parts. If the verification patterns are the same, you have entered the key part correctly.

Note: When the CKDS is enciphered under the master key, ICSF stores the master key verification pattern in the CKDS header record. Checking the verification pattern is optional; it is not required for key entry.

To generate the value for a key part, you can use one of the following methods:

- Choose a random number yourself.
- Access the ICSF utility panels to generate a random number.
- Call the random number generate callable service. For more information, see the *OS/390 ICSF Application Programmer's Guide*.

  Note: ICSF must be initialized to access the utility panels or use the random number generate callable service.

The following topics describe the methods you can use to generate key parts, checksums, and verification patterns.

Generating Key Parts Using ICSF Utilities

1. Access ICSF utilities by choosing option 5, UTILITY, on the Integrated Cryptographic Service Facility primary menu panel, as shown in Figure 122 on page 147.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 5

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
```

Figure 122. ICSF Selecting the Utility Option on the Primary Menu Panel

The Utilities panel appears. See Figure 123. You use the RANDOM and CHECKSUM options to generate random numbers, checksums, and verification patterns for master key management.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities --------------------------
OPTION ===> 3


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
```

Figure 123. ICSF Utilities Panel

2. Choose option 3, RANDOM, to access the Random Number Generator panel, shown in Figure 124.
3. To select the parity of the random numbers, enter ODD, EVEN, or RANDOM next to the Parity Option and press ENTER.

   The master key must have odd parity.

   Note: The combined master key is forced to have odd parity, but the parity of the individual key parts can be odd, even, or mixed. We refer to even or mixed parity keys as non-odd parity keys.

   A random 16-digit number appears in each of the Random Number Fields. You can use each of these random numbers for a half of a key part.

```
CSFRNG00 ---------------- OS/390 ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option   ===>  ODD                ODD, EVEN, RANDOM
  Random Number1     :  1A2B3C4D5E6F1334   Random Number 1
  Random Number2     :  A1B2133C3D489EF8   Random Number 2
  Random Number3     :  9B28AEFA8C47760F   Random Number 3
```

Figure 124. ICSF Random Number Generator Panel

Note: Random number 3 is used for PKA keys, which are not supported on the ICRF.

4. *Record random number 1 and random number 2* so you can enter them as the key part halves into the KSU.
5. Press END to return to the Utilities panel.
6. Continue with Generating a Checksum, a Verification Pattern, and a Hash Pattern for a Key Part.

Generating a Checksum, a Verification Pattern, and a Hash Pattern for a Key Part

You can use the ICSF utilities panel to generate a checksum, an optional verification pattern, and an optional hash pattern for a key part. You can use this panel to generate the checksum even if ICSF has not been initialized. The random number generator and the verification pattern, however, do not work until ICSF has been initialized with a valid master key.

Note: When you use these utility panels to generate key parts, checksums, verification patterns, and hash patterns, the key part value is exposed in storage for the duration of the dialogues. For this reason, you can choose to calculate these values either manually or by use of a PC program. See Checksum Algorithm, for a description of the checksum algorithm. See Algorithm for Calculating a Verification Pattern, for a description of the algorithm for the verification pattern. See The MDC–4 Algorithm for Generating Hash Patterns, for a description of the algorithm for the hash pattern. The use of the verification pattern or hash pattern is optional.

Follow these steps to generate a checksum, an optional verification pattern, and an optional hash pattern for a key part.

1. Select option 4, CHECKSUM, on the ICSF Utilities panel as shown in Figure 125.

```
CSFUTL00 ---------------- OS/390 ICSF - Utilities -------------------------
OPTION ===> 4


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
```

Figure 125. Selecting the Checksum Option on the ICSF Utilities Panel

The Checksum and Verification Pattern panel appears. See Figure 126 on page 149.

```
CSFMKV00 ------------ OS/390 ICSF - Checksum and Verification Pattern -----
COMMAND ===>


Enter data below:

  Key Type        ===>                   (Selection panel will display if blank)

  Key Part First  ===>  51ED9CFA90716CFB  Input first key part
  Key Part Middle ===>  58403BFA02BD13E8  Input middle key part
  Key Part Last   ===>  9B28AEFA8C47760F  Input last key part (PKA keys only)

  Checksum           :  00                Check digit for key part
  Key Part VP        :  0000000000000000  Verification Pattern
  Key Part HP        :  0000000000000000  Hash Pattern
                     :  0000000000000000
```

Figure 126. ICSF Checksum and Verification Pattern Panel

If you accessed the Random Number Generator panel before this panel, the random numbers that are generated appear automatically in the Key Part Left and Key Part Right fields. You can skip the next step.

2. If you did not use the ICSF panels to generate random numbers, enter the random numbers for which you want to create checksum and verification patterns into these fields.
3. In the Key Type field, specify the key type for which you are generating a key part checksum and verification pattern.

   If you leave the Key Type field blank and press ENTER, you access the Key Type Selection panel, as shown in Figure 127.

```
CSFMKV10 ------------- OS/390 ICSF - Key Type Selection Panel ------  ROW    1 OF 7
COMMAND ===>                                                 SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   EXPORTER   Export key-encrypting key
   IMP-PKA    Limited authority importer
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
s  MASTER     DES master key
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
   PKAMSTR    PKA master key
****************************** BOTTOM OF DATA *************************
```

Figure 127. Key Type Selection Panel Displayed During Hardware Key Entry

4. Type s to the left of the appropriate key type, and press ENTER to return to the Checksum and Verification Pattern panel.

```
CSFMKV00 ------------ OS/390 ICSF - Checksum and Verification Pattern -----
COMMAND ===>


Enter data below:

  Key Type        ===>  MASTER           (Selection panel will display if blank)
  Key Part First  ===>  51ED9CFA90716CFB  Input first key part
  Key Part Middle ===>  58403BFA02BD13E8  Input middle key part
  Key Part Last   ===>  0000000000000000  Input last key part (PKA keys only)

  Checksum           :  00                Check digit for key part
  Key Part VP        :  0000000000000000  Verification Pattern
  Key Part HP        :  0000000000000000  Hash Pattern
                     :  0000000000000000
```

Figure 128. ICSF Checksum and Verification Pattern Panel

5. On the Checksum and Verification Pattern panel, press ENTER.

   ICSF calculates the checksum, the verification pattern, and the hash pattern for the key part halves and displays them on the panel.

6. *Record the checksum* so you can enter it after you enter the key part halves into the KSU.
7. *Record the verification pattern* so you can compare it with the verification pattern that is displayed on a panel after you enter the key part.
8. *Record the hash pattern* so you can compare it with the hash pattern that is displayed on a panel after you enter the key part.

   Attention: Save these values even after you enter a master key. If the ICRF detects tampering, it clears the master key, and you have to reenter the same master key again.

9. Press END to return to the Utilities panel.
10. Return to “Generating Key Parts Using ICSF Utilities” on page 146 and follow the steps to create as many key parts as you need to enter the master key.

After you generate the key parts, the checksums, the verification patterns, and the hash patterns continue with:

- “Entering Master Key Parts Manually” on page 161 if you are entering a master key.
- “Entering Operational Keys” on page 186 if you are entering an operational key.

Entering Master Keys

If you have an ICRF with keypad and Personal Security card reader, you can use either the Personal Security card reader or the keypad to enter master key parts. If you have an ICRF with hand-held key-entry unit (KEU), you can use the KEU to enter the clear value of master key parts. In either case, you also use the ICSF panels during the master key entry steps.

These procedures assume that the terminal and KSU are located near each other so you can switch back and forth between accessing the panels and doing procedures on the KSU. If the terminal and KSU are not located together, you can

access the panels and give instructions over the telephone to a security officer at the KSU.

To distinguish between the steps that take place at the terminal and those that take place at the KSU note the following convention. The terminal panel steps appear in a normal style font. **The KSU steps appear in a bold style font.**

- If you have a Personal Security card that contains the master key part data, continue with "Entering Master Key Parts with Personal Security Cards."
- If you are entering master key parts manually, and need to generate the key part data before you begin, continue with "Generating Key Part Data for Manual Key Entry" on page 145.
- If you have the key part data, continue with "Entering Master Key Parts Manually" on page 161.

Entering Master Key Parts with Personal Security Cards

If you have an ICRF with keypad and Personal Security card reader, you can enter key parts that are stored on Personal Security cards.

This procedure involves entering two or more key parts and is divided into three main tasks:

1. Entering the first master key part from a Personal Security card
2. Entering intermediate master key parts from a Personal Security card
3. Entering the final master key part from a Personal Security card

Entering the First Master Key Part from a Personal Security Card

To begin entering the first master key part, start at the terminal panels and follow the instructions below:

1. Select option 1, MASTER KEY, on the primary menu panel, as shown in Figure 129.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
```

Figure 129. Selecting the Master Key Option on the ICSF Primary Menu Panel

2. Select option 1, ENTER, on the Master Key Management panel, as shown in Figure 130 on page 152.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a KSU
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 130. Selecting the Enter Option on the Master Key Management Panel

The KSU Selection panel, which may be similar to the one in Figure 131, appears.

3. Select the KSU for master key entry by typing the KSU number on the OPTION line and pressing ENTER.

   Note: If you have only one KSU installed, or if there is only one KSU defined to this logical partition (LP), this panel will only show one KSU.

```
CSFMKP10 -------------------- OS/390 ICSF - KSU Selection -----------------
OPTION ===> 0

                                                              CRYPTO DOMAIN: 0

Enter the number of the KSU to be used for key part input.

KSU/REGISTER STATUS        0. KSU 0               1. KSU 1

  Crypto CPs installed      : 0                     : 3
  Crypto CPs active         : 0                     : 3
  Physical switch position  : NORMAL                : NORMAL
  Key Part register         : DISABLED AND EMPTY    : DISABLED AND EMPTY
  New Master Key register   : EMPTY                 : EMPTY
  NMK verification pattern  :                       :
  Old Master Key register   : EMPTY                 : EMPTY
  OMK verification pattern  :                       :
  Master Key register       : VALID                 : VALID
  MK verification pattern   : 1294ABCD5678EF91      : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED              : DISABLED

Press ENTER to select KSU and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 131. Selecting a KSU for Master Key Entry

The Enter New Master Key panel appears. See Figure 132 on page 153.

4. Select option 1, ENTER A KEY PART, to begin the key part entry steps.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 1


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 132. Selecting the Enter Key Part Option on the Enter New Master Key Panel

The Enter First Master Key Part panel appears. See Figure 133.

```
CSFEKP01------------------ OS/390 ICSF - Enter First Master Key Part-------

OPTION  ===>


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

If ICRF, set the physical key switch to position NMK 1 using Brass Key #1

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 133. The Enter First Master Key Part Panel

5. **At the KSU, insert brass key #1 into Key Switch 1 and turn it to the Enter NMK(1) position.**

   To insert or remove the brass keys, the key switches must be in the Normal position.

6. At the panel terminal, press ENTER to display status.

   The Enter First Master Key Part panel appears. See Figure 134 on page 154. Notice that the physical switch position is now NMK1 and that the key part register status has changed to ENABLED and EMPTY. This indicates that the physical switch on the KSU has been correctly turned to the Enter NMK(1) position.

```
CSFEKP10--------------- OS/390 ICSF - Enter First Master Key Part ---------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 1
                       Key part register status         : ENABLED AND EMPTY
                       New master key register status   : EMPTY

If KSU 0 has a slot for a Personal Security Card, enter the key part
by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 134. Enter First Master Key Part Panel with Key Part Register Status Enabled

7. **At the KSU, insert the Personal Security card that contains the first master key part into the card reader slot on the KSU. The card should be inserted logo-side up with the gold contacts first.**

   During the key entry process, a four-line alphanumeric liquid crystal display (LCD) screen on the KSU displays messages. Follow the prompts on the KSU display screen, and refer to the supporting KSU help panels for instructions on the key entry process. The functions that are assigned to each of the function keys on the KSU are shown on the right-hand side of the display screen.

   The KSU reads the serial number and card ID from the Personal Security card and displays this information.

8. **Check that the KSU display shows the correct values for card ID, application ID, or serial number for the Personal Security card.**

   - **If the card data is correct for the ICRF, press Enter (F2) on the KSU.**
   - **If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.**

   The KSU searches the Personal Security card for an NMK(1) data block. If more than one NMK(1) data block exists, the KSU displays a list of data block names.

9. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

   The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

10. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

11. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

    The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

    If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the

IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide for additional information.

12. Press ENTER on the ICSF terminal to return to the Enter New Master Key panel.

    Note: Do not switch the operator key switch position from the Enter NMK1 position before you press ENTER, or the key part is lost.

13. **At the KSU, rotate brass key #1 to the Normal position and remove it.**

You have completed the process to enter the first key part. Therefore, the first key part is in the new master key register. When you complete the process to enter another key part, this other key part is be combined with the first key part in the new master key register.

You are now ready to enter an intermediate or final key part. A new master key can be made up of just a first key part and a final key part. A new master key may also have one or more optional intermediate key parts. You should have a Personal Security card for each key part.

If you have one or more Personal Security cards with intermediate key parts to load, continue with "Entering Intermediate Key Parts from a Personal Security Card."

If you want to enter a final key part, continue with "Entering the Final Key Part from a Personal Security Card" on page 157.

Entering Intermediate Key Parts from a Personal Security Card

If you want to enter more than two key parts, you must enter one or more intermediate key parts between entering the first key part and the final key part.

1. Choose option 1 on the Enter New Master Key panel and press ENTER. Refer to Figure 135.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 1


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : PART FULL

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 135. Selecting the Enter Key Part Option to Enter an Intermediate Key Part

The Enter Master Key Part panel appears. See Figure 136 on page 156.

```
CSFEKP01--------------- OS/390 ICSF - Enter Master Key Part ---------------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NORMAL
                       Key part register status         : DISABLED AND EMPTY
                       New master key register status   : PART FULL



If ICRF, set the physical key switch to position NMK 2 using Brass Key #2

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 136. Enter Master Key Part Panel for Entering an Intermediate Key Part before Turning Key Switch

2. **At the KSU, insert brass key #2 into key switch 2 and turn the switch to the Enter NMK(2) position.**

   The KSU alphanumeric display shows NMK2 after you turn the switch to the Enter NMK(2) position and the key part register is enabled.

3. At the panel terminal, press ENTER.

   The Enter Master Key Part panel appears. See Figure 137.

```
CSFEKP10--------------- OS/390 ICSF - Enter Master Key Part ---------------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 2
                       Key part register status         : ENABLED AND EMPTY
                       New master key register status   : PART FULL

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 137. Enter Master Key Part Panel for Entering Intermediate Key after Turning Key Switch

   The current physical switch position is Enter NMK(2). Because the key part register is now able to receive data but you have not yet entered an intermediate key part, the key part register status is ENABLED and EMPTY.

4. **At the KSU, insert the Personal Security card that contains the intermediate master key part into the card reader slot on the KSU.**

   The KSU reads the serial number and card ID from the Personal Security card and displays this information.

5. **Check that the KSU display shows the correct values for card ID, application ID, or serial number for the Personal Security card.**

   - **If the card data is correct for the ICRF, press Enter (F2) on the KSU.**

- **If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.**

The KSU searches the Personal Security card for an NMK(2) data block. If more than one NMK(2) data block exists, the KSU displays a list of data block names.

6. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

   The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

7. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

8. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

   The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

   If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide* for additional information.

9. At the ICSF panel terminal, press ENTER to accept the key part.

   The key part is transferred from the key part register to the new master key register, where it is combined with the first key part.

   Note: Do not switch the operator key switch position from the Enter NMK2 position before you press ENTER, or the key part is lost.

10. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter an intermediate master key part. If you have more intermediate master key parts, repeat this task as many times as necessary. After you enter all the intermediate parts, enter the final key part as described in Entering the Final Key Part from a Personal Security Card.

Entering the Final Key Part from a Personal Security Card

The Enter Final Master Key Part panel appears. After you enter the first key part, and any intermediate key parts, you then enter the final master key part as explained here:

1. Select option 2, Enter a Final Key Part on the Enter New Master Key panel, as shown in Figure 138 on page 158, and press ENTER.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 2


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : PART FULL

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 138. Selecting to Enter a Final Key Part on the Enter New Master Key Panel

See Figure 139.

```
CSFEKP01--------------- OS/390 ICSF - Enter Final Master Key Part ---------
COMMAND ===>

                     KSU selected for new master key  : 0
                     Current physical switch position : NORMAL
                     Key part register status         : DISABLED AND EMPTY
                     New master key register status   : PART FULL



If ICRF, set the physical key switch to position NMK 2 using Brass Key #2

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 139. Enter Final Master Key Part Panel with Key Part Register Status Disabled

2. **At the KSU, insert brass key #2 into key switch 2 and turn it to the Enter NMK(2) position.**

   The KSU alphanumeric display now shows NMK2.

3. At the ICSF panel terminal, press ENTER.

   The Enter Final Master Key Part panel changes as shown in Figure 140 on page 159. The current operator key switch position is Enter NMK(2). Because the key part register is now able to receive data but you have not yet entered the final key part, the key part register status is ENABLED and EMPTY.

```
CSFEKP10--------------- OS/390 ICSF - Enter Final Master Key Part ---------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 2
                       Key part register status         : ENABLED AND EMPTY
                       New master key register status   : PART FULL

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 140. Enter Final Master Key Part Panel with Key Part Register Status Enabled

4. **At the KSU, insert the Personal Security card that contains the final master key part into the card reader slot on the KSU.**

   The KSU reads the serial number and card ID from the Personal Security card and displays this information.

5. **Check that the KSU display shows the correct values card ID, application ID, or serial number for the Personal Security card.**

   - If the card data is correct for the ICRF, press Enter (F2) on the KSU.
   - If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.

   The KSU searches the Personal Security card for an NMK(2) data block. If more than one NMK(2) data block exists, the KSU displays a list of data block names.

6. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

   The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

7. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

8. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

   The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

   If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide* for additional information.

9. At the ICSF panel terminal, press ENTER.

The key part is transferred from the key part register to the new master key register, where it is combined with the first key part and any intermediate key parts.

Note: Do not switch the operator key switch position from the Enter NMK2 position before you press ENTER, or the key part is lost.

The Enter Master Key Part panel appears after you press ENTER. See Figure 141.

```
CSFEKP20 ----------- OS/390 ICSF - Enter Final Master Key Part ------------
COMMAND ===>

                      KSU selected for new master key  : 0
                      Current physical switch position : NMK 2
                      Key part register status         : DISABLED AND EMPTY
                      New master key register status   : FULL


 Verification pattern for the entered key part is:

   37FCA59404545718          (Record and secure this pattern.)


Verification pattern for the new master key is:

   80A21615D9E38C4B          (Record and secure this pattern.)

Set the physical switch position to NORMAL using Brass Key #2.

Press END   to exit to the previous menu
```

Figure 141. Enter Final Master Key Part Panel Showing Verification Patterns for the Final Key Part and Master Key

The new master key register status is now FULL, and the panel displays two verification patterns. It gives you a verification pattern for the final key part, and one for the new master key, since it is now complete.

10. Check that the key part verification pattern you may have previously calculated matches the verification pattern that appears on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see “Restarting the Key Entry Process” on page 175.
11. *Record the verification pattern* for the new master key, because you may want to verify it at another time.

    Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the master key into the CKDS header record.
12. **If you entered the key part correctly, use brass key #2 to turn the operator key switch to the Normal position, and remove brass key #2.**
13. At the ICSF panel terminal, press END to return to the Enter New Master Key panel.

When you have entered the master key correctly, the master key is in the new master key register and is not active on the system yet. After you enter the master key, you should do *one* of the following:

- If you are defining the master key for the first time, initialize the CKDS with the master key. “Initializing the CKDS at First-Time Startup” on page 176 describes the process of initializing a master key on your system.
- If you are defining a master key after it was cleared, set the master key to make it active. For a description of the process of recovering from tampering, see “Reentering the Master Key After It was Cleared” on page 180.
- If you are changing a master key, reencipher the CKDS under the new master key and make it active. “Changing the Master Key” on page 181 describes the process of changing a master key.

Entering Master Key Parts Manually

Depending on the style of KSU on your processor, you can enter key parts manually using either the keypad or the hand-held KEU. Follow these instructions regardless of the style of KSU on your processor. In most cases, when there is a minor difference between the keypad and the hand-held KEU steps, the keypad variation appears first followed by the hand-held KEU variation in parentheses. When there are major differences between the two versions of the hardware, the instructions direct you to the sequence of steps for your hardware.

This procedure involves entering two or more key parts and is divided into three main tasks:

1. Entering the First Master Key Part Manually
2. Entering Intermediate Master Key Part Manually
3. Entering the Final Master Key Part Manually

Entering the First Master Key Part Manually

To begin entering the first master key part, start at the terminal panels and follow the instructions below:

1. Select option 1, MASTER KEY, on the primary menu panel, as shown in Figure 142.

```
CSF@PRIM ----Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
```

Figure 142. Selecting the Master Key Option on the ICSF Primary Menu Panel

2. Select option 1, ENTER, on the Master Key Management panel, as shown in Figure 143 on page 162.

```
CSFMKM00 ---------------- OS/390 ICSF - Master Key Management -------------
OPTION ===>  1


Enter the number of the desired option.

  1  ENTER  -  Enter a new master key to a KSU
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 143. Selecting the Enter Option on the Master Key Management Panel

The KSU Selection panel, which may be similar to the one in Figure 144, appears.

3. Select the KSU for master key entry by typing the KSU number on the OPTION line and pressing ENTER.

   Note: If you have only one KSU installed, or if there is only one KSU defined to this LP, this panel will only show one KSU.

```
CSFMKP10 -------------------- OS/390 ICSF - KSU Selection -----------------
OPTION ===> 0

                                                              CRYPTO DOMAIN: 0

Enter the number of the KSU to be used for key part input.

KSU/REGISTER STATUS        0. KSU 0               1. KSU 1

  Crypto CPs installed      : 0                     : 3
  Crypto CPs active         : 0                     : 3
  Physical switch position  : NORMAL                : NORMAL
  Key Part register         : DISABLED AND EMPTY    : DISABLED AND EMPTY
  New Master Key register   : EMPTY                 : EMPTY
  NMK verification pattern  :                       :
  Old Master Key register   : EMPTY                 : EMPTY
  OMK verification pattern  :                       :
  Master Key register       : VALID                 : VALID
  MK verification pattern   : 1294ABCD5678EF91      : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED              : DISABLED

Press ENTER to select KSU and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 144. Selecting a KSU for Master Key Entry

The Enter New Master Key panel appears. See Figure 145 on page 163.

4. Select option 1, ENTER A KEY PART, to begin the key part entry steps.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 1


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 145. Selecting the Enter Key Part Option on the Enter New Master Key Panel

The Enter First Master Key Part panel appears. See Figure 146.

```
CSFEKP01------------------ OS/390 ICSF - Enter First Master Key Part-------

OPTION  ===>


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

If ICRF, set the physical key switch to position NMK 1 using Brass Key #1

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 146. The Enter First Master Key Part Panel

5. **At the KSU, insert brass key #1 into Key Switch 1 (Key Switch) and turn it to the Enter NMK(1) position.**

   To insert or remove the brass keys, the key switch must be in the Normal position.

6. At the panel terminal, press ENTER to display status.

   The Enter First Master Key Part panel appears. See Figure 147 on page 164. Notice that the physical switch position is now NMK1 and that the key part register status has changed to ENABLED and EMPTY. This indicates that the physical switch on the KSU has been correctly turned to the Enter NMK(1) position.

```
CSFEKP10--------------- OS/390 ICSF - Enter First Master Key Part ---------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 1
                       Key part register status         : ENABLED AND EMPTY
                       New master key register status   : EMPTY

If KSU 0 has a slot for a Personal Security Card, enter the key part
by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 147. Enter First Master Key Part Panel with Key Part Register Status Enabled

If you are using the keypad, continue with "Using the Keypad to Enter Master Key Parts Manually."

If you are using the hand-held KEU, continue with "Using the Hand-Held KEU to Enter Master Key Parts Manually" on page 165.

Using the Keypad to Enter Master Key Parts Manually

1. **At the KSU, press the Clear key.**

   This clears and turns on the KSU display screen.

2. **Press the Clear Entry key.**

   The cursor appears in the leftmost position of the Left Half Key (LHK) input area.

3. **Enter the 16 digits of the LHK.**

   An asterisk (*) appears for each digit you enter. When you have entered all 16 digits of the LHK, the cursor moves to the leftmost position of the Right Half Key (RHK) input area.

4. **Enter the 16 digits of the RHK.**

   Note: If you make a mistake when entering digits, press the Clear Entry key as many times as necessary to delete the incorrect digits from the display screen.

   After you enter the 16 digits of the RHK, the cursor moves to the leftmost position of the checksum (CkSum) input area.

5. **Enter the two-digit checksum.**

   If the checksum you enter matches the checksum the ICRF calculates, you have entered the key part correctly. The KSU displays the position of the operator key switch.

   If the checksums do not match, the checksum field on the display screen is blanked out, and the message `Checksum Error` appears. If this occurs, follow this sequence to resolve the problem:

   a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

6. When you have entered the first key part successfully, continue with "Completing Manual Master Key Part Entry" on page 167.

Using the Hand-Held KEU to Enter Master Key Parts Manually

1. **Plug the hand-held KEU into the port on the KSU.**
2. **Press the CLR key.**

   This clears and turns on the KEU display screen.
3. **Press the CE key.**

   A red dot lights up next to the digit 0, indicating that the KEU is ready. The Key Entry Enabled light on the KSU lights if the KSU is able to accept the data.

   Note: If you do not press the CE key after the CLR key, the KEU display starts to flash after you enter the third digit. To clear this error condition, press the CLR and CE keys.
4. **Turn the rotary switch on the KSU to the Enter 1-16 position.**

   The KSU display should show `K`, indicating that the KSU is ready to start the key entry process. If any other message appears, refer to the KSU Display Message list in Figure 148 on page 166 for the meaning and action.
5. **Enter the 16 digits of the first key part.**

   As you enter each digit, it appears on the KEU alphanumeric display. The numbers 1 through 16 also appear in sequence on the KSU alphanumeric display. For example, when you enter the first digit, `K=01` appears on the KSU display.

   Note: If you make a mistake when entering digits, press the CE key as many times as necessary to delete the incorrect digits from the display screen.
6. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.**

   The KSU display should display `K`.
7. **Press the CLR and CE keys on the KEU.**
8. **Enter the last 16 digits of the key part.**

   As you enter the digits, the digits display on the KEU alphanumeric display. The numbers 17 through 32 appear in sequence on the KSU alphanumeric display.
9. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.**

   The KSU display should show `K`.
10. **Press the CLR key and CE key on the KEU.**

11. Enter the first digit of the two-digit checksum.

    If you entered all 32 digits of the key part, the KSU display should show `K=C0`.

12. **Enter the second digit of the checksum.**

    The checksum verifies that you entered a key part correctly without accidentally transposing the digits or pressing the wrong digit on the KEU keypad.

    If the checksum you enter matches the checksum that the ICRF calculates, you have entered the key part correctly. The Key Entry Enabled light on the KSU turns off, and the KSU display shows the position of the operator key switch.

Figure 148. Meaning of KSU Display Messages

KSU Display Message	Meaning and Action
K	The KSU is ready to receive entries. Begin entering the appropriate key part or checksum.
K↑ER	Either: • The rotary switch should be in the Enter 1-16 position and is not. Press the CLR and CE keys, turn the rotary switch to another position and then back to the Enter 1-16 position. • If the rotary switch is in the checksum position, this indicates you have not entered all 16 digits of the first half of the key part. Press the CLR and CE keys, turn the rotary switch to the Enter 1-16 position and reenter the key part.
K=01 through K=32	The number relates to the digit of the key part that has been entered. Continue entering key part digits.
K=C0	The rotary switch is in the Checksum position and you have entered the first digit of the checksum. This messages indicates that you have entered all 32 digits of a key part. Enter the second digit of the checksum.
K↓ER	Either: • The rotary switch should be in the Enter 17-32 position and is not. Press the CLR and CE keys, turn the rotary switch to another position and then back to the Enter 17-32 position. • If the rotary switch is in the checksum position, this indicates you have not entered all 16 digits of the second of the key part. Press the CLR and CE keys, turn the rotary switch to the Enter 17-32 position and reenter the key part.
K+ER	The checksum you entered does not match the one calculated by the ICRF. First, press the CLR and CE keys and reenter the checksum. If this does not clear the error, recalculate the checksum and reenter it if your calculations result in a different number. If the error persists, reenter the two half of the key part again.
K@ER	You did not clear the KEU before entering the checksum. Press the CLR and CE keys and reenter the checksum.

Completing Manual Master Key Part Entry

1. At the ICSF panel terminal, press ENTER to transfer the key part to the new master key register.

   The Enter First Master Key Part panel appears. See Figure 149.

   Note: Do not switch the operator key switch position from the Enter NMK1 position before you press ENTER, or the key part is lost.

```
CSFEKP20--------------- OS/390 ICSF - Enter First Master Key Part ---------
COMMAND ===>

                KSU selected for new master key  : 0
                Current physical switch position : NMK1
                Key part register status         : DISABLED AND EMPTY
                New master key register status   : PART FULL


Verification pattern for the entered key part is:

   1A2B3C4D8E5F67E9         (Record and secure this pattern.)
```

Figure 149. Enter First Master Key Part Panel Showing Verification Pattern

   Because you entered the first master key part, the status of the new master key register is changed to PART FULL.

   The panel displays a verification pattern for the key part, which the ICRF calculates.

2. If you calculated the verification pattern for the key part before you began the key entry process, you can compare it to the pattern that is displayed on the panel. For more information about how to calculate the verification pattern for a key part, see “Generating Key Part Data for Manual Key Entry” on page 145.
3. *Record this verification pattern* so you can use it later. For example, if your processor complex has a second KSU, you need to reenter the same key part in the second unit. When you reenter the key part, you can check that the verification patterns the panels display are the same.
4. **At the KSU, rotate brass key #1 to the Normal position and remove it.**

You have completed the process to enter the first key part. Therefore the first key part is in the new master key register. When you complete the process to enter another key part, the other key part is combined with the first key part in the new master key register.

You are now ready to enter an intermediate or final key part. A new master key can be made up of just a first key part and a final key part. A new master key may also have one or more optional intermediate key parts.

If you have one or more intermediate key parts to enter, continue with “Entering Intermediate Key Parts Manually” on page 168.

If you want to enter a final key part, continue with “Entering the Final Key Part Manually” on page 171.

Entering Intermediate Key Parts Manually

If you want to enter more than two key parts, you must enter one or more intermediate key parts between entering the first key part and the final one.

1. Choose option 1 on the Enter New Master Key panel and press ENTER. Refer to Figure 150.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 1


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : PART FULL

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 150. Selecting the Enter Key Part Option to Enter an Intermediate Key Part

The Enter Master Key Part panel appears. See Figure 151.

```
CSFEKP01--------------- OS/390 ICSF - Enter Master Key Part ---------------
COMMAND ===>

                     KSU selected for new master key  : 0
                     Current physical switch position : NORMAL
                     Key part register status         : DISABLED AND EMPTY
                     New master key register status   : PART FULL



If ICRF, set the physical key switch to position NMK 2 using Brass Key #2

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 151. Enter Master Key Part Panel for Entering an Intermediate Key Part before Turning Key Switch

2. **At the KSU, insert brass key #2 into key switch 2 (key switch) and turn the switch to the Enter NMK(2) position.**

   The KSU alphanumeric display shows `NMK2` after you turn the switch to the Enter NMK(2) position and the key part register is enabled.

3. At the panel terminal, press ENTER.

   The Enter Master Key Part panel appears. See Figure 152 on page 169.

```
CSFEKP10--------------- OS/390 ICSF - Enter Master Key Part ---------------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 2
                       Key part register status         : ENABLED AND EMPTY
                       New master key register status   : PART FULL

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 152. Enter Master Key Part Panel for Entering Intermediate Key after Turning Key Switch

The current physical switch position is Enter NMK(2). Because the key part register is now able to receive data and you have not yet entered an intermediate key part, the key part register status is ENABLED and EMPTY.

4. **At the KSU, enter the intermediate key part by using the same steps as you did for the first key part.**

   Figure 153 presents the basic steps.

Figure 153. Basic Steps for Keypad and Hand-Held KEU

Keypad	Hand-Held KEU
1. **Press the Clear key.** 2. **Press the Clear Entry key.** 3. **Enter the 16 digits of the LHK.** 4. **Enter the 16 digits of the RHK.** 5. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The KSU displays the position of the operator key switch.	1. **Press the CLR key.** 2. **Press the CE key.** 3. **Turn the rotary switch on the KSU to the Enter 1-16 position.** 4. **Enter the 16 digits of the first key part.** 5. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.** 6. **Press the CLR and CE keys on the KEU.** 7. **Enter the last 16 digits of the key part.** 8. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.** 9. **Press the CLR key and CE key on the KEU.** 10. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The Key Entry Enabled light on the KSU turns off and the KSU display shows the position of the operator key switch.

5. At the ICSF panel terminal, press ENTER to transfer the key part to the new master key register. The Enter First Master Key Part panel appears. See Figure 154.

   Note: Do not switch the operator key switch position from the Enter NMK2 position before you press ENTER, or the key part is lost.

```
CSFEKP20--------------- OS/390 ICSF - Enter Master Key Part ---------
COMMAND ===>

                KSU selected for new master key  : 0
                Current physical switch position : NMK2
                Key part register status         : DISABLED AND EMPTY
                New master key register status   : PART FULL


Verification pattern for the entered key part is:

   1A2B3C4D8E5F67E9         (Record and secure this pattern.)
```

Figure 154. Enter Master Key Part Panel Showing Verification Pattern

Because you entered the first master key part, the status of the new master key register is changed to PART FULL.

The panel displays a verification pattern for the key part, which the ICRF calculates.

6. If you calculated the verification pattern for the key part before you began the key entry process, you can compare it to the pattern that is displayed on the panel. For more information about how to calculate the verification pattern for a key part, see “Generating Key Part Data for Manual Key Entry” on page 145.
7. *Record this verification pattern* so you can use it later. For example, if your processor complex has a second KSU, you need to reenter the same key part in the second unit. When you reenter the key part, you can check that the verification patterns the panels display are the same.
8. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter an intermediate master key part. If you have more intermediate master key parts, repeat this task as many times as necessary.

After you enter all the intermediate parts, enter the final key part as described in Entering the Final Key Part Manually.

Entering the Final Key Part Manually

After you enter the first key part, and any intermediate key parts, you then enter the final master key part as explained here:

1. Select option 2, Enter a Final Key Part on the Enter New Master Key panel and press ENTER. Refer to Figure 155.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 2


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : PART FULL

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 155. Selecting to Enter a Final Key Part on the Enter New Master Key Panel

The Enter Final Master Key Part panel appears. See Figure 156.

```
CSFEKP01--------------- OS/390 ICSF - Enter Final Master Key Part ---------
COMMAND ===>

                     KSU selected for new master key  : 0
                     Current physical switch position : NORMAL
                     Key part register status         : DISABLED AND EMPTY
                     New master key register status   : PART FULL


If ICRF, set the physical key switch to position NMK 2 using Brass Key #2

If using TKE, preload the key part queue with key parts in the proper
order and restart from the previous panel.
```

Figure 156. Enter Final Master Key Part Panel with Key Part Register Status Disabled

2. **At the KSU, insert brass key #2 into key switch 2 (key switch) to the Enter NMK(2) position.**

   The KSU alphanumeric display now shows NMK2.

3. At the ICSF panel terminal, press ENTER.

   The Enter Final Master Key Part panel changes as shown in Figure 157. The current operator key switch position is Enter NMK(2). Because the key part register is now able to receive data but you have not yet entered the final key part, the key part register status is ENABLED and EMPTY.

```
CSFEKP10--------------- OS/390 ICSF - Enter Final Master Key Part ---------
COMMAND ===>

                        KSU selected for new master key  : 0
                        Current physical switch position : NMK 2
                        Key part register status         : ENABLED AND EMPTY
                        New master key register status   : PART FULL

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

If using a Key Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to  1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.

If using TKE, press ENTER.
```

Figure 157. Enter Final Master Key Part Panel with Key Part Register Status Enabled

4. **At the KSU, enter the final key part by using the same steps as you did for the first key part.**

   The basic steps are presented below. For more detailed step-by-step instructions return to “Using the Keypad to Enter Master Key Parts Manually” on page 164.

Figure 158. Basic Steps for Keypad and Hand-Held KEU

Keypad	Hand-Held KEU
1. **Press the Clear key.** 2. Press the Clear Entry key. 3. **Enter the 16 digits of the LHK.** 4. **Enter the 16 digits of the RHK.** 5. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The KSU displays the position of the operator key switch.	1. **Press the CLR key.** 2. **Press the CE key.** 3. **Turn the rotary switch on the KSU to the Enter 1-16 position.** 4. **Enter the 16 digits of the first key part.** 5. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.** 6. **Press the CLR and CE keys on the KEU.** 7. **Enter the last 16 digits of the key part.** 8. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.** 9. **Press the CLR key and CE key on the KEU.** 10. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The Key Entry Enabled light on the KSU turns off and the KSU display shows the position of the operator key switch.

5. At the ICSF panel terminal, press ENTER.

   The key part is transferred from the key part register to the new master key register, where it is combined with the first key part and any intermediate key parts.

   Note: Do not switch the operator key switch position from the Enter NMK2 position before you press ENTER, or the key part is lost.

   The Enter Master Key Part panel appears after you press ENTER. See Figure 159 on page 174.

```
CSFEKP20 ----------- OS/390 ICSF - Enter Final Master Key Part ------------
COMMAND ===>

                       KSU selected for new master key  : 0
                       Current physical switch position : NMK 2
                       Key part register status         : DISABLED AND EMPTY
                       New master key register status   : FULL


 Verification pattern for the entered key part is:

   37FCA59404545718          (Record and secure this pattern.)


Verification pattern for the new master key is:

   80A21615D9E38C4B          (Record and secure this pattern.)

Set the physical switch position to NORMAL using Brass Key #2.

Press END   to exit to the previous menu
```

Figure 159. Enter Final Master Key Part Panel Showing Verification Patterns for the Final Key Part and Master Key

The new master key register status is now FULL, and the panel displays two verification patterns. It gives you a verification pattern for the final key part, and one for the new master key, since it is now complete.

6. Check that the key part verification pattern you may have previously calculated matches the verification pattern that is shown on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see “Restarting the Key Entry Process” on page 175.
7. *Record the verification pattern* for the new master key, because you may want to verify it at another time.

   Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the master key into the CKDS header record.
8. **If you entered the key part correctly, use brass key #2 to turn the operator key switch to the Normal position, and remove brass key #2.**
9. At the ICSF panel terminal, press END to return to the Enter New Master Key panel.

When you have entered the master key correctly, the master key is in the new master key register and is not active on the system yet. After you enter the master key, you should do *one* of the following:

- If you are defining the master key for the first time, initialize the CKDS with the master key. “Initializing the CKDS at First-Time Startup” on page 176 describes the process of initializing a master key on your system.
- If you are defining a master key after it was cleared, set the master key to make it active. For a description of the process of recovering from tampering, see “Reentering the Master Key After It was Cleared” on page 180.
- If you are changing a master key, reencipher the CKDS under the new master key and make it active. “Changing the Master Key” on page 181 describes the process of changing a master key.

Restarting the Key Entry Process

If you realize that you made an error when entering a key part, you can restart the process of entering the new master key. For example, if the verification pattern that the ICRF calculates does not correspond to the one that you calculated, you may want to restart the process. Restarting the key entry process causes the new master key register to be cleared, which means that all the new master key parts you entered previously are erased.

Note: When you enter the first key part, your old master key is lost, even if you restart the process.

To restart the key entry process, follow the steps below:

1. Back out of whatever panel you are accessing until you reach the Enter New Master Key panel.
2. Choose option 3, the RESTART KEY ENTRY PROCESS option, on the Enter New Master Key panel. Refer to Figure 160.

```
CSFEKM00------------------ OS/390 ICSF - Enter New Master Key -----------

OPTION  ===> 3


                    KSU selected for new master key  : 0
                    Current physical switch position : NORMAL
                    Key part register status         : DISABLED AND EMPTY
                    New master key register status   : EMPTY

Enter the number of the desired option above.

  1  ENTER A KEY PART          -  Enter a key part into NMK register
  2  ENTER A FINAL KEY PART    -  Enter a final key part into NMK register
  3  RESTART KEY ENTRY PROCESS -  Clear the NMK register
```

Figure 160. Selecting the Restart Key Entry Process Option on the Enter New Master Key Panel

When you choose option 3, the Confirm Restart Request panel appears. See Figure 161.

```
CSFEKM30--------------- OS/390 ICSF - Confirm Restart Request -------------
COMMAND ===>


ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the new master key register.




Press ENTER to confirm restart request
Press END   to cancel restart request
```

Figure 161. Confirm Restart Request Panel

This panel confirms your request to restart the key entry process.

3. If you want to restart the key entry process, press ENTER.

The restart request automatically empties the key part register and new master key register.

4. If you do not want to restart, press END.

   After you make a choice, you return to the Master Key Management panel, which is shown in Figure 130 on page 152.

5. Either begin the key entry process again or exit that panel to return to the ICSF primary menu panel.

Initializing the CKDS at First-Time Startup

The first time you start ICSF, you must enter a DES master key, create a cryptographic key data set (CKDS), and initialize the CKDS. When you initialize the CKDS, ICSF creates a header record for the CKDS, installs the required system keys in the CKDS, and sets the DES master key. ICSF enciphers all the keys that are stored in a CKDS under the master key. After you define the master key and initialize a CKDS, you can generate or enter any additional system keys you need to perform cryptographic functions.

There are four different types of system keys you can install in the CKDS:

- Required system keys
- NOCV enablement keys
- ANSI system keys
- Enhanced system keys

You must be on the right level of hardware to use callable services that require some of the system keys. For a description of the system keys, see “Entering System Keys into the Cryptographic Key Data Set (CKDS)” on page 26.

You have to only initialize a CKDS the first time you start ICSF on a system. After you initialize a CKDS, you can copy the disk copy of the CKDS to create other CKDSs for use on the system. You can also use a CKDS on another ICSF system if the system has the same master key value. At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see “Refreshing the CKDS at Any Time” on page 178.

To define a master key and initialize a CKDS:

1. Use the master key panels to enter a master key into the new master key register.

   For a description of how to enter the master key, see “Entering Master Key Parts Manually” on page 161.

2. Use the CKDS Initialization panels to initialize the CKDS, set the master key, and install the required system keys in the CKDS.

To initialize the CKDS, perform the following steps:

1. When you have completed master key entry, leave the master key panels and access the CKDS panel by choosing option 6 on the Integrated Cryptographic Service Facility panel, as shown in Figure 162 on page 177.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility  ---------
OPTION ===> 6

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
```

Figure 162. ICSF Selecting the CKDS Initialization Option on the Primary Menu Panel

The Initialize a CKDS panel appears. See Figure 163.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 163. ICSF Initialize a CKDS Panel

2. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

   The name you enter should be the same name that is specified in the CKDSN installation option in the installation options data set. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see the *OS/390 ICSF System Programmer's Guide*.

3. Choose option 1, Initialize an empty CKDS, and press ENTER.

   ICSF creates the header record in the disk copy of the CKDS. Next, ICSF sets the DES master key. ICSF then adds the required system keys to the CKDS and refreshes the CKDS. When ICSF completes all these steps, the message `INITIALIZATION COMPLETE` appears. If you did not enter a master key into the new master key register previously, the message `NMK REGISTER NOT FULL` appears and the initialization process ends. You must enter a master key into the new master key register before you can initialize the CKDS.

   Note: If any part of the option 1 fails, you must delete the CKDS and start over. If the failure occurs after the master key has been set and before the system keys have been created, you will need to reset the master keys.

4. If you want ICSF to create NOCV-enablement keys after the initialization process has been completed, select option 2, NOCVKEYS, and press ENTER.

The creation of NOCV-enablement keys is optional. It allows you to use either the key generator utility program or the Key Token Build callable service to create NOCV keys. NOCV keys allow you to send and receive keys from systems that do not use control vectors. For a description of NOCV keys, see the description of the NOCV keyword for the key generator utility program in 223.

Note: If you want to run the ICSF conversion program to convert a CUSP/PCF CKDS into ICSF format, the CKDS you start ICSF with must contain NOCV-enablement keys. For more information about the conversion program, see the *OS/390 ICSF System Programmer's Guide*.

5. To create ANSI system keys that are used for the ANSI X9.17 services, choose option 3, ANSI.

   The creation of ANSI system keys is optional. ANSI system keys are required if you intend to also create enhanced system keys.

   The message `ANSI KEYS ADDED` appears on the top right of the panel, if the process succeeds.

6. To create enhanced system keys, choose option 4, ESYS.

   The creation of enhanced system keys is optional. Enhanced system keys are useful if you are creating a CKDS that will be used on either an S/390 G3 Enterprise Server, or higher or S/390 Multiprise server. To create enhanced system keys, you must have previously installed the ANSI system keys in the CKDS.

   The message `ESYS KEYS ADDED` appears on the top right of the panel, if the process succeeds.

After you complete the entire process, a master key and CKDS exist on your system. You can now generate keys using the key generate callable service and key generator utility program or convert CUSP/PCF keys to ICSF keys using the conversion program. You can also enter keys directly into the KSU or indirectly by use of KGUP. ICSF services use the keys to perform the cryptographic functions you request.

Note: You enable special secure mode to initialize ICSF for the first time. After you perform the initialization process, you may choose to disable special secure mode.

Refreshing the CKDS at Any Time

After you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use KGUP to add and update any of the disk copies of the CKDS on your system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage CKDS. For information about using KGUP, see Chapter 8, “Managing Cryptographic Keys by Using the Key Generator Utility Program” on page 213. For information on using the dynamic CKDS callable services, refer to the *OS/390 ICSF Application Programmer's Guide*. You can also use your system hardware add keys to a disk copy of the CKDS. Depending on the version of ICRF installed on your processor, you may have use Personal Security cards, the keypad on the KSU, or the KEU to enter keys. For information about manually entering keys into the CKDS, see “Entering Operational Keys” on page 186.

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS at any time without disrupting cryptographic functions. Use the following steps:

1. Enter option 6, CKDS, on the ICSF Primary Menu panel to access the Initialize a CKDS panel, which is shown in Figure 164.

   Note: Before you refresh a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

```
CSFCKD00 ---------------- OS/390 ICSF - Initialize a CKDS  ----------------
COMMAND ===>  5


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'PIN1.CKDS'
```

Figure 164. Selecting the Refresh Option on the ICSF Initialize a CKDS Panel

2. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.
3. Choose option 5, REFRESH, and press ENTER.

   ICSF places the disk copy of the CKDS that you specified into storage. Partial keys that may exist when you enter keys manually are not loaded into storage during a REFRESH. A REFRESH does not interrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.

   After ICSF reads the CKDS is read into storage, it performs a MAC verification on each record in the CKDS. If a record fails the MAC verification, ICSF sends a message that contains the key label and type for that record to the MVS security console. You can then use either KGUP or the dynamic CKDS update services to delete the record from the CKDS. Any other attempts to access a record that has failed MAC verification results in a return code and reason code that indicate that the MAC is not valid.
4. Press END to return to the Integrated Cryptographic Service Facility panel.

Note: You can also use a KGUP panel or a utility program to refresh the CKDS. For information about these other methods, see “Refreshing the In-Storage CKDS” on page 247.

Reentering the Master Key After It was Cleared

In certain situations, the ICRF clears the master key registers so that the master key value is not disclosed. the ICRF clears the master key in the following situations:

- The ICRF detects tampering.

  Note: During hardware maintenance of the ICRF, you may need to replace hardware that holds the master key. When you replace this hardware, the ICRF detects tampering and clears the master key.

- On an ICRF with hand-held key-entry unit, if you turn the physical key in the mode switch to the **Zeroize** position and press the **Lamp Test** button on the KSU.
- On an ICRF with keypad and Personal Security card reader, if you turn the mode select key switch to the **Zeroize** position and press **F1** on the KSU.

Although the value of the master key is cleared, the keys in the CKDS are still enciphered under that master key. Therefore, to recover the keys in the CKDS, you must reenter the same master key and activate it. For security reasons, you may then want to change the master key.

PR/SM Considerations: If you are running in PR/SM logical partition (LPAR) mode, the ICRF causes all LPs to lose their master keys. For each LP, you must access the KSU by use of the KE field on the PR/SM LPSEC frame and reenter the master key. For more information about reentering master keys in LPAR mode, see Appendix C, “PR/SM Considerations during Key Entry” on page 331.

After the ICRF clears the master key, reenter the same master key by following these steps:

1. Retrieve the key part, checksum, and verification pattern values you used when you entered the key originally.

   Store these values in a secure place as specified in your enterprise's security process.

2. Access the master key entry panels and enter the master key as described in “Entering Master Key Parts Manually” on page 161.

   After you enter the new master key, the Master Key Management panel appears. See Figure 165 on page 181.

   To make the master key you just entered active, you need to set it.

3. To set the master key, choose option 2 on the panel and press ENTER.

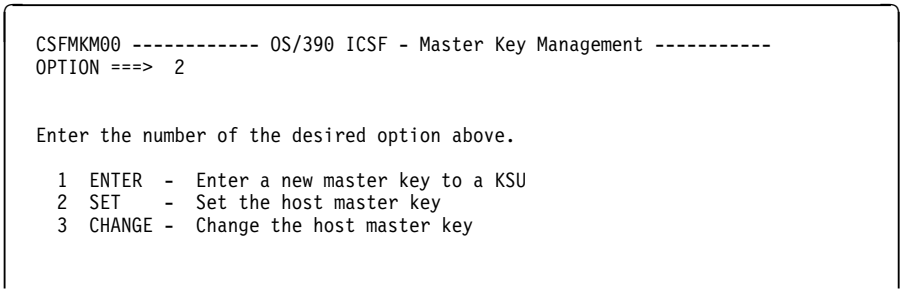

Figure 165. Selecting the Set Host Master Key Option on the ICSF Master Key Management Panel

After you select option 2, ICSF checks that the states of the registers are correct. ICSF then transfers the master key from the new master key register to the master key register. This process sets the master key.

When ICSF attempts to set the master key, it displays a message on the top right of the Master Key Management panel. The message indicates either that the master key was successfully set, or that an error prevented the completion of the set process.

Note:

If your system is using two KSUs, ICSF sets the master key for each KSU whose new master key enciphers the in-storage CKDS. You should reenter the master key into the new master key register for each of the KSUs.

Your processor complex may have more than one processor with one or two KSUs. ICSF sets the master key for every KSU whose new master key value enciphers the in-storage CKDS. The operating system console receives messages that state that the ICRF is offline and then online for each KSU. These actions should not affect cryptographic operations. However, if a KSU does not have either a current master key or a new master key that enciphers the current in-storage CKDS, the KSU is left offline.

When you set the reentered master key, the master key that enciphers the existing CKDS now exists.

4. You can now change the master key, if you choose to, for security reasons. Continue with “Changing the Master Key.”

Changing the Master Key

For security reasons your installation should change the master key periodically. In addition, you may also want to change the master key after you reenter it after it was cleared.

There are three main steps involved in changing the master key:

1. Enter the master key parts.
2. Reencipher the CKDS under the new master key.
3. Activate the new master key.

For step-by-step procedure for changing the master key, reenciphering the CKDS, and activating the new master key, refer to “Changing the Master Key Using the Master Key Panels” on page 183. This section provides some background on the contents of the master key registers during the key change process, and some compatibility mode considerations.

A master key and a CKDS that contains keys that are enciphered under that master key already exist. Before you replace this existing master key with the new master key, you must reencipher the CKDS under the new master key.

Note: Before you reencipher a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Disallowing Dynamic CKDS Updates During KGUP Updates” on page 214.

If you changed the master key previously, an old master key exists in the auxiliary master key register. The currently active master key exists in the master key register. When you enter the key parts of the new master key into the auxiliary master key register, the previous content of that register (the old master key) is lost.

To make the new master key the current active master key, you have ICSF move the new master key from the auxiliary master key register into the master key register. At the same time, ICSF moves the value that was in the master key register to the auxiliary key register where it is stores as the old master key.

Before the new master key is placed into the master key register, you must reencipher all disk copies of the CKDS under the new master key. Then you are ready to activate the master key. When you change the master key, ICSF replaces the in-storage copy of the CKDS with the reenciphered disk copy and makes the new master key active on the system.

The procedures you use to activate the new master key depend on whether your system is running compatibly with the either the Cryptographic Unit Support Program (CUSP) or the Programmed Cryptographic Facility (PCF).

ICSF runs in noncompatibility, compatibility, or co-existence mode. You specify which mode ICSF runs in by using an installation option. For a description of the modes and how to specify an installation option, see the *OS/390 ICSF System Programmer's Guide*.

In noncompatibility mode, ICSF allows you to change the master key with continuous operations. Therefore applications can continue to run without disruption.

In all three modes, you enter the new master key and reencipher the disk copy of the CKDS under the new master key using the master key panels. In noncompatibility mode, you then activate the new master key and refresh the in-storage copy of the CKDS with the disk copy using the master key panels or a utility program.

In compatibility mode and coexistence mode, activating the new master key and refreshing the in-storage copy of the CKDS does not reencipher internal key tokens under the new master key. ICSF applications that hold internal key tokens that are enciphered under the wrong master key will fail with a warning message.

Applications that use the CUSP and PCF macros, however, run with no warning message and produce erroneous results.

The safest method to follow after changing the master key in either compatibility or coexistence mode is as follows:

1. Ensure that the name of the new CKDS is in the installation data set.
2. Re-IPL MVS.
3. Start CSF.

A re-IPL ensures that a program does not use a key that is encrypted under a different master key to access a cryptographic service. If a program is using an operational key, the program should either re-create or reimport the key, or generate a new key.

If a re-IPL is not practical in your installation, consider this alternative method. Stop all cryptographic applications, especially those using CUSP or PCF macros, before activating the new master key and refreshing the in-storage copy of the CKDS. This eliminates all operational keys that are encrypted under the current master key. After you start CSF again, applications using an operational key can either re-create or reimport the key.

Changing the Master Key Using the Master Key Panels

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering Master Key Parts Manually” on page 161.

   The new master key register must be full before you change the master key.

2. Select option 3, CHANGE, on the Master Key Management panel and press ENTER. Refer to Figure 166.

   Note: If your system is using two KSUs, they must have the same master key. When you change the master key in one KSU, you should change the master key in the other KSU. Therefore, before you can reencipher a CKDS under a new master key, the new master key registers in both KSUs must contain the same value.

```
CSFMKM00 ------------ OS/390 ICSF - Master Key Management -----------
OPTION ===>  3


Enter the number of the desired option above.

  1  ENTER  -  Enter a new master key to a KSU
  2  SET    -  Set the host master key
  3  CHANGE -  Change the host master key
```

Figure 166. Selecting the Change Master Key Option on the ICSF Master Key Management Panel

This takes you to the Change/Reencipher panel, which is shown in Figure 167 on page 184.

```
CSFCMM00 ------------- OS/390 ICSF - Change/Reencipher --------------
OPTION  ===>


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 167. Change/Reencipher Panel

Before you change the master key, you must first reencipher the disk copy of the CKDS under the new master key.

3. To reencipher a disk copy, choose option 1 on the Change/Reencipher panel.

   The Reencipher CKDS panel appears. See Figure 168.

```
CSFCMK10 ------------- OS/390 ICSF - Reencipher CKDS ----------------
COMMAND ===>


To reencipher all CKDS entries from encryption under the current master key
to encryption under the new master key enter the CKDS names below.


    Input CKDS ===> CKDS.CURRENT.MASTER

   Output CKDS ===> CKDS.NEW.MASTER
```

Figure 168. Reencipher CKDS

4. In the Input CKDS field, enter the name of the CKDS that you want to reencipher. In the Output CKDS field, enter the name of the data set in which you want to place the reenciphered keys.

   Note: The output data set should already exist although it must be empty. For more information about defining a CKDS, see the *OS/390 ICSF System Programmer's Guide*.

   Reenciphering the disk copy of the CKDS does not affect the in-storage copy of the CKDS. On this panel, you are working with only a disk copy of the CKDS.

5. Press ENTER to reencipher the input CKDS entries and place them into the output CKDS.

   The message `REENCIPHER SUCCESSFUL` appears on the top right of the panel if the reencipher succeeds.

6. If you have more than one CKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the CKDS, you are ready to change the master key.

7. Press END to return to the Change/Reencipher panel.

   Changing the master key involves refreshing the in-storage copy of the CKDS with a disk copy and activating the new master key.

8. If you are running in compatibility or coexistence mode, *do not* select option 2, the CHANGE option. To activate the changed master key when running in compatibility or coexistence mode, you need to re-IPL MVS and start ICSF. This activates the changed master key and refreshes the in-storage CKDS. To do this, you must exit the panels at this time.
9. If you are running in noncompatibility mode, to change the master key select option 2 on the Change/Reencipher panel, as shown in Figure 169.

```
CSFCMM00 ------------- OS/390 ICSF - Change/Reencipher --------------
OPTION  ===> 2


Enter the number of the desired option above.

 1.  REENCIPHER - Reencipher a CKDS to the new master key
 2.  CHANGE     - Change the master key
```

Figure 169. Selecting the Change Master Key Option on the Change/Reencipher Panel

When you press ENTER, the Change Master Key panel appears. See Figure 170.

```
CSFCMK20 ----------------- OS/390 ICSF Change Master Key ------------
COMMAND ===>


Enter the name of the new CKDS below:

  New CKDS ===> CKDS.NEW.MASTER

When the master key is changed, the new CKDS will become active.
```

Figure 170. Change Master Key Panel

10. In the New CKDS field, enter the name of the disk copy of the CKDS that you want in storage.

    You should have already reenciphered the disk copy of the CKDS under the new master key. The last CKDS name that you specified in the Output CKDS field on the Reencipher CKDS panel automatically appears in this field. See Figure 168 on page 184.
11. Press ENTER.

    ICSF loads the data set into storage, where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

    After you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that did not permit the change process to be completed. For example, if you indicate a data set that is not reenciphered under the new master key, an error message is displayed and the master key is not changed.

Notes:

a. If your system is using two KSUs, ICSF activates the new master key only if each KSU contains a new master key value that enciphers the CKDS that you specify on the Change Master Key panel. You must enter the new master key into each of the KSUs, before you perform the change.

b. Your processor complex may have more than one processor with one or two KSUs. ICSF activates the new master key only if every KSU contains a new master key value that enciphers the CKDS you specified on the Change Master Key panel. When the change occurs, the system operation console receives messages that state that the ICRF is offline and then online for each KSU. These actions should not affect cryptographic operations.

You can use a utility program to reencipher the CKDSs and change the master key instead of using the panels. “Reenciphering a Disk Copy of a CKDS and Changing the Master Key” on page 317 describes how to use the utility program for these procedures.

Entering Operational Keys

On an ICRF with keypad and Personal Security card reader, you can enter a key part stored on a Personal Security card, or you can use the KSU keypad to manually enter the clear value of a key part. On an ICRF with hand-held key-entry unit (KEU), you can use the KEU to enter the clear value of a key part. In either case, you also use the ICSF panels during the key entry steps.

These procedures assume that the terminal and KSU are located near each other. This makes it easier to switch back and forth between accessing the panels and doing procedures on the KSU. If the terminal and KSU are not located together, you can access the panels and give instructions over the telephone to a security officer at the KSU.

To distinguish between the steps that take place at the terminal and those that take place at the KSU, note the folowing convention. The terminal panel steps appear in a normal style font. **The KSU steps appear in a bold style font.**

When you enter a key part, the ICRF enciphers the key part under a variant of your system's master key. It then stores the key part in the CKDS. Therefore, the key never appears in clear form in system storage. You might use the KSU to enter a clear key if another site has a courier deliver a Personal Security card that contains a key value or a clear key value for you to enter into your system's CKDS.

- If you have a Personal Security card that contains the operational key part data, continue with “Entering Operational Key Parts with Personal Security Cards” on page 187.
- If you are entering key parts manually, and need to generate the key part data before you begin, continue with “Generating Key Part Data for Manual Key Entry” on page 145.
- If you have the key part data, continue with “Entering Operational Key Parts Manually” on page 198.

Entering Operational Key Parts with Personal Security Cards

If you have an ICRF with keypad and Personal Security card reader, you can enter key parts that are stored on Personal Security cards.

This procedure involves entering two or more key parts and is divided into three main tasks:

1. Entering the first operational key part from a Personal Security card
2. Entering intermediate operational key parts from a Personal Security card
3. Entering the final operational key part from a Personal Security card

Entering the First Operational Key Part from a Personal Security Card

To begin entering the first operational key part, start at the terminal panels and follow the instructions below:

1. Select option 4, OPKEY, on the primary menu panel, as shown in Figure 171.

```
CSF@PRIM -----Integrated Cryptographic Service Facility  ---------
OPTION ===> 4

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 171. Selecting the Master Key Option on the ICSF Primary Menu Panel

   The KSU Selection panel appears. It may be similar to the one shown in Figure 172 on page 188.

2. Select the KSU for operational key entry by typing the KSU number on the OPTION line and pressing ENTER.

   Note: If you have only one KSU installed, or if there is only one KSU defined to this LP, this panel will only show one KSU.

```
CSFMKP10 -------------------- OS/390 ICSF - KSU Selection -----------------
OPTION ===> 0

                                                              CRYPTO DOMAIN: 0

Enter the number of the KSU to be used for key part input.

KSU/REGISTER STATUS        0. KSU 0               1. KSU 1

  Crypto CPs installed      : 0                    : 3
  Crypto CPs active         : 0                    : 3
  Physical switch position  : NORMAL               : NORMAL
  Key Part register         : DISABLED AND EMPTY   : DISABLED AND EMPTY
  New Master Key register   : EMPTY                : EMPTY
  NMK verification pattern  :                      :
  Old Master Key register   : EMPTY                : EMPTY
  OMK verification pattern  :                      :
  Master Key register       : VALID                : VALID
  MK verification pattern   : 1294ABCD5678EF91     : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED             : DISABLED

Press ENTER to select KSU and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 172. Selecting a KSU for Operational Key Entry

The Operational Key Input panel appears. See Figure 173.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                        KSU selected for new key         : 0
                        Current physical switch position : NORMAL
                        Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'BURROUG.HCRP210.CKDS'
Key label ==>
Key type  ==>              Selection panel displayed if blank
Key part  ==>              FIRST, MIDDLE or FINAL

For FINAL key part enter the following information.

  Adjust parity      ===>              YES or NO
  Control Vector     ===>              YES or NO
  Installation data  ===>

Press ENTER to select the data set and the key.
Press END  to exit to the previous menu.
```

Figure 173. Operational Key Input Panel

All the panels for entering key parts show status information at the top. It shows the KSU you selected, the position of operator key switch, and the status of the key part register. At this point, the operator key switch should be in the **Normal** position, and the key part register should be disabled.

3. In the CKDS name field, enter the name of the disk copy of the CKDS in which the key parts and, eventually, the entire key will be stored.

   This CKDS name field defaults to the name of the disk copy of the CKDS last used to refresh the in-storage CKDS.

4. In the Key label field, specify the label of the entry on the CKDS in which the key parts and, eventually, the entire key will be stored.
5. In the Key type field, enter the type of key you want to enter.

   You can enter any of the following types of keys:

   EXPORTER Exporter key-encrypting key
   IMPORTER Importer key-encrypting key
   PINGEN PIN generation key
   PINVER PIN verification key
   IPINENC Input PIN-encrypting key
   OPINENC Output PIN-encrypting key

   If you leave the field blank and press ENTER, the Key Type Selection panel appears. See Figure 174.
6. Type s to the left of the key type you want to specify from the displayed list of key types and press ENTER.

   Note: Although the IMP-PKA appears on this panel, it is not selectable on bipolar processors.

   In Figure 174, the EXPORTER key is selected.

```
CSFCSE12 ---------- OS/390 ICSF - Key Type Selection Panel ----------  ROW 1 OF 6
COMMAND ===>                                                 SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
s  EXPORTER   Export key-encrypting key
   IMP-PKA    Limited authority importer key
   IMPORTER   Import key-encrypting key
   IPINENC    PIN-encryption input key-encrypting key
   OPINENC    PIN-encryption output key-encrypting key
   PINGEN     PIN generation key-encrypting key
   PINVER     PIN verification key-encrypting key
****************************** BOTTOM OF DATA ********************************
```

Figure 174. Selecting a Key Type on the Key Type Selection Panel

7. In the Key part field, enter FIRST for the first key part.

   Figure 175 shows an example of the Operational Key Input panel with the first key part.

```
CSFSCK10 -------- OS/390 ICSF - Operational Key Input ---------------
COMMAND ===>

                        KSU selected for new key         : 0
                        Current physical switch position : NORMAL
                        Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'NICHOLS.HCRP210.CKDS'
Key label ==> EXPORTERATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> FIRST        FIRST, MIDDLE or FINAL
```

Figure 175. The Operational Key Input Panel Filled in for a First Key Part

8. When you have specified all the information, press ENTER.

   Since you are entering the first key part, the key label on the CKDS should not already exist. ICSF will create an entry with the key label you specify, and the Operational Key Input panel appears. See Figure 177 on page 191.

   However, if you specified a key label that already exists, the Operational Key Input panel appears. See Figure 176.

   Note: This panel appears only if the key represented by the existing label is a null key or a partial key. If the label represents a complete key, then an error message "NOT A PARTIAL KEY" will appear in the upper right corner of the panel.

```
CSFSCK40 -------------- OS/390 ICSF - Operational Key Input ----------------------
 COMMAND ===>

 A record with the following specifications has been found in the
selected CKDS:

  Key label  : EXPORTERATOB
  Key type   : EXPORTER









 Press ENTER to replace the existing record.
 Press END   to exit to the previous menu.
```

Figure 176. Operational Key Input Panel

This panel alerts you that even though you are entering the first key part, an entry in the CKDS under the label you specified already exists. The panel displays the key label and key type for the entry.

- If you want to replace the existing key with the new key that you are about to enter, press ENTER.

  The new key value will replace the existing key under that label in the CKDS. The Operational Key Input panel appears. See Figure 177 on page 191.

- If you do not want to overwrite the existing key under this label, do the following:

  a. Press END.

     You return to the previous Operational Key Input panel, which is shown in Figure 175 on page 189.

  b. Specify a different key label that does not already exist and press ENTER.

The Operational Key Input panel appears. See Figure 177 on page 191. The operator key switch should be in the Normal position when this panel appears, and the KSU alphanumeric display will be blank.

```
CSFSCK20 -------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP1 using Brass Key #1.
```

Figure 177. Operational Key Input Panel

9. **At the KSU, insert brass key #1 into Key Switch 1 and turn it to the Enter KP1 position.**

   To insert or remove a brass key, the key switch must be in the Normal position. After you turn the switch to the **Enter KP1** position, KP1 appears on the KSU alphanumeric display.

10. At the panel terminal, press ENTER to display status.

    The Operational Key Input panel appears. See Figure 178.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                           KSU selected for new key         : 0
                           Current physical switch position : KP1
                           Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.



Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 178. Operational Key Input Panel

The current operator key switch position is Enter KP1, and the key part register status is enabled and empty.

11. **At the KSU, insert the Personal Security card that contains the first operational key part into the card reader slot on the KSU. The card should be inserted logo-side up with the gold contacts first.**

During the key entry process, a four-line alphanumeric liquid crystal display (LCD) screen on the KSU displays messages. Follow the prompts on the KSU display screen, and refer to the supporting KSU help panels for instructions on the key entry process. The right-hand side of the display screen shows the functions that are assigned to each of the function keys on the KSU.

The KSU reads the serial number and card ID from the Personal Security card and displays this information.

12. **Check that the KSU display shows the correct values for card ID, application ID, or serial number for the Personal Security card.**
    - **If the card data is correct for the ICRF, press Enter (F2) on the KSU.**
    - **If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.**

    The KSU searches the Personal Security card for a KP1 data block. If more than one KP1 data block exists, the KSU displays a list of data block names.

13. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

    The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

14. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

15. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

    The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

    If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide* for additional information.

16. Press ENTER on the ICSF terminal to return to the Operational Key Input panel.

    Note: Do not switch the operator key switch position from the Enter KP1 position before you press ENTER, or the key part is lost.

17. **At the KSU, rotate brass key #1 to the Normal position and remove it.**

You have completed the process to enter the first key part. Therefore, the first key part has been transferred from the key part register to the key label in the CKDS you specified. When you complete the process to enter another key part, the other key part is combined with the first key part in the CKDS.

You are now ready to enter a middle or final key part. An operational key can be made up of just a first key part and a final key part. An operational key may also have one or more optional middle key parts. You should have a Personal Security card for each key part.

If you have one or more Personal Security cards with middle key parts to load, continue with “Entering Middle Operational Key Parts from a Personal Security Card” on page 193.

If you want to enter a final key part, continue with “Entering the Final Operational Key Part from a Personal Security Card” on page 195.

Entering Middle Operational Key Parts from a Personal Security Card

If you want to enter more than two key parts, you must enter one or more intermediate key parts between entering the first key part and the final key part.

1. In the key part field on the Operational Key Input panel, specify MIDDLE, as shown in Figure 179, and press ENTER.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                         KSU selected for new key         : 0
                         Current physical switch position : NORMAL
                         Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'NICHOLS.HCRP210.CKDS'
Key label ==> EXPORTERATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> MIDDLE       FIRST, MIDDLE or FINAL
```

Figure 179. Specifying a Middle Key Part on the Operational Key Input Panel

The Operational Key Input panel appears. See Figure 180.

```
CSFSCK20 -------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP2 using Brass Key #2.
```

Figure 180. Operational Key Input Panel

2. **At the KSU, insert brass key #2 into Key Switch 2 and turn the switch to the Enter KP2 position.**

   The KSU alphanumeric display shows KP2 after you turn the switch to the Enter KP2 position and the key part register is enabled.

3. At the panel terminal, press ENTER to display status.

   The Operational Key Input panel appears. See Figure 181 on page 194.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                           KSU selected for new key         : 0
                           Current physical switch position : KP2
                           Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.




Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 181. Operational Key Input Panel

The current physical switch position is Enter KP2. Because the key part register is now able to receive data but you have not yet entered an intermediate key part, the key part register status is ENABLED AND EMPTY.

4. **At the KSU, insert the Personal Security card that contains the middle key part into the card reader slot on the KSU.**

   The KSU reads the serial number and card ID from the Personal Security card and displays this information.

5. **Check that the KSU display shows the correct values for card ID, application ID, or serial number for the Personal Security card.**

   - If the card data is correct for the ICRF, press Enter (F2) on the KSU.
   - If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.

   The KSU searches the Personal Security card for a KP2 data block. If more than one KP2 data block exists, the KSU displays a list of data block names.

6. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

   The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

7. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

8. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

   The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide* for additional information.

9. At the ICSF panel terminal, press ENTER to accept the key part.

   The key part is transferred from the key part register to the CKDS, where it is combined with the first key part.

   Note: Do not switch the operator key switch position from the Enter KP2 position before you press ENTER, or the key part is lost.

10. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter a middle operational key part. If you have more middle key parts, repeat this task as many times as necessary.

After you enter all the middle key parts, enter the final key part as described in Entering the Final Operational Key Part from a Personal Security Card.

Entering the Final Operational Key Part from a Personal Security Card

To enter a final operational key part, follow these steps:

1. In the Key part field on the Operational Key Input panel, specify FINAL.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                         KSU selected for new key         : 0
                         Current physical switch position : NORMAL
                         Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'BURROUG.HCRP210.CKDS'
Key label ==> EXPORTATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> FINAL        FIRST, MIDDLE or FINAL

For FINAL key part enter the following information.

  Adjust parity      ===> YES          YES or NO
  Control Vector     ===> YES          YES or NO
  Installation data  ===> EXPORTER A TO B INSTALLED 03/01/97

Press ENTER to select the data set and the key.
Press END  to exit to the previous menu.
```

Figure 182. Operational Key Input Panel

2. In the Adjust parity field, specify YES if you want ICSF to adjust the parity to odd.

   Any key ICSF generates has odd parity. However, ICSF allows you to enter a key with odd or non-odd parity. A key with non-odd parity will function on ICSF, but ICSF will return an even parity reason code for many functions in which the key is used. Although ICSF runs with odd or non-odd parity, your installation may choose to run with just odd parity keys.

3. In the Control Vector field, specify YES or NO.

For all types of keys except transport keys, specify YES. If you want to enter a transport key, you can specify either YES or NO. If you specify NO, the transport key is flagged for use in NOCV processing. In NOCV processing, ICSF uses the transport key itself rather than a transport key variant to encrypt keys. NOCV processing is used to exchange keys with products that do not use control vectors.

4. In the Installation data field, enter any information your installation wants to specify about the key.

   ICSF stores this information in the installation data field of the CKDS.

   Figure 182 on page 195 shows this panel filled in for the final key part.

5. Press ENTER.

   The Operational Key Input panel appears. See Figure 183.

```
CSFSCK20--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP2 using Brass Key #2.
```

Figure 183. Operational Key Input Panel

6. **At the KSU, insert brass key #2 into Key Switch 2 and turn the switch to the Enter KP2 position.**

   The KSU alphanumeric display shows KP2 after you turn the switch to the Enter KP2 position and the key part register is enabled.

7. At the panel terminal, press ENTER to display status.

   The Operational Key Input panel appears. See Figure 184 on page 197.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                           KSU selected for new key         : 0
                           Current physical switch position : KP2
                           Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.




Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 184. Operational Key Input Panel

The current physical switch position is Enter KP2. Because the key part register is now able to receive data but you have not yet entered a final key part, the key part register status is ENABLED AND EMPTY.

8. **At the KSU, insert the Personal Security card that contains the final key part into the card reader slot on the KSU.**

   The KSU reads the serial number and card ID from the Personal Security card and displays this information.

9. **Check that the KSU display shows the correct values for card ID, application ID, or serial number for the Personal Security card.**

   - If the card data is correct for the ICRF, press Enter (F2) on the KSU.
   - If the card data is not correct for the ICRF, quit the sequence by pressing Exit (F3) on the KSU to eject the card.

   The KSU searches the Personal Security card for a KP2 data block. If more than one KP2 data block exists, the KSU displays a list of data block names.

10. **Use the up and down cursor movement keys to select the correct data block, and press Enter (F2) on the KSU to read the data.**

    The KSU then reads the key part data from the selected data block. If a valid key part is found and successfully read, the KSU displays a description and the verification pattern.

11. **If you generated, calculated, or received a verification pattern with the key part, check the verification pattern on the KSU display screen against it.**

12. **If the verification patterns match, accept the key part value by pressing Enter (F2) on the KSU.**

    The KSU automatically ejects the Personal Security card after you press Enter to accept the key part value.

If an error occurs while the KSU is reading a data block from the Personal Security card, an error message appears on the display screen. Refer to the *IBM ES/9000 ES/3090 Integrated Cryptographic Feature User's Guide* for additional information.

13. At the ICSF panel terminal, press ENTER to accept the key part.

    ICSF transfers the key part from the key part register to the CKDS, where it is combined with the first key part and any middle key parts.

    Note: Do not switch the operator key switch position from the Enter KP2 position before you press ENTER, or the key part is lost.

14. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter the final operational key part.

Entering Operational Key Parts Manually

Depending on the style of KSU on your processor, you can enter key parts manually using either the keypad or the hand-held KEU. Follow these instructions regardless of which style of KSU is installed on your processor. In most cases, when there is a minor difference between the keypad and the hand-held KEU steps, the keypad variation appears first followed by the hand-held KEU variation in parentheses. When there are major differences between the two versions of the hardware, the steps will direct you to the correct sequence of steps for your hardware.

This procedure involves entering two or more key parts and is divided into three main tasks:

1. Entering the First Operational Key Part Manually
2. Entering Middle Operational Key Parts Manually
3. Entering the Final Operational Key Part Manually

Entering the First Operational Key Part Manually

To begin entering the first operational key part, start at the terminal panels and follow the instructions below:

1. Select option 4, OPKEY, on the primary menu panel, as shown in Figure 185.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility  ---------
OPTION ===> 4

Enter the number of the desired option.

  1  MASTER KEY    -  Enter, set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 185. Selecting the Master Key Option on the ICSF Primary Menu Panel

   The KSU Selection panel, which may be similar to the one in Figure 186 on page 199, appears.

2. Select the KSU for operational key entry by typing the KSU number on the OPTION line and pressing ENTER.

Note: If you have only one KSU installed, or if there is only one KSU defined to this LP, this panel will only show one KSU.

```
CSFMKP10 -------------------- OS/390 ICSF - KSU Selection -----------------
OPTION ===> 0

                                                          CRYPTO DOMAIN: 0

Enter the number of the KSU to be used for key part input.

KSU/REGISTER STATUS        0. KSU 0               1. KSU 1

  Crypto CPs installed      : 0                    : 3
  Crypto CPs active         : 0                    : 3
  Physical switch position  : NORMAL               : NORMAL
  Key Part register         : DISABLED AND EMPTY   : DISABLED AND EMPTY
  New Master Key register   : EMPTY                : EMPTY
  NMK verification pattern  :                      :
  Old Master Key register   : EMPTY                : EMPTY
  OMK verification pattern  :                      :
  Master Key register       : VALID                : VALID
  MK verification pattern   : 1294ABCD5678EF91     : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED             : DISABLED

Press ENTER to select KSU and proceed to new master key part entry.
Press END   to exit to the previous menu.
```

Figure 186. Selecting a KSU for Operational Key Entry

The Operational Key Input panel appears. See Figure 187.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                        KSU selected for new key         : 0
                        Current physical switch position : NORMAL
                        Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'BURROUG.HCRP210.CKDS'
Key label ==>
Key type  ==>              Selection panel displayed if blank
Key part  ==>              FIRST, MIDDLE or FINAL

For FINAL key part enter the following information.

  Adjust parity      ===>             YES or NO
  Control Vector     ===>             YES or NO
  Installation data  ===>

Press ENTER to select the data set and the key.
Press END  to exit to the previous menu.
```

Figure 187. Operational Key Input Panel

All the panels for entering key parts show status information at the top. The KSU you selected before entering key parts, either 0 or 1, is displayed. The operator key switch position is shown. At this point, the operator key switch should be in the **Normal** position, and the key part register should be disabled.

3. In the CKDS name field, enter the name of the disk copy of the CKDS in which the key parts and, eventually, the entire key will be stored.

This CKDS name field defaults to the name of the disk copy of the CKDS last used to refresh the in-storage CKDS.

4. In the Key label field, specify the label of the entry on the CKDS in which the key parts and, eventually, the entire key will be stored.
5. In the Key type field, enter the type of key you want to enter.

   You can enter any of the following types of keys:

   EXPORTER Exporter key-encrypting key
   IMPORTER Importer key-encrypting key
   PINGEN PIN generation key
   PINVER PIN verification key
   IPINENC Input PIN-encrypting key
   OPINENC Output PIN-encrypting key

   If you leave the field blank and press ENTER, the Key Type Selection panel appears. See Figure 188.
6. Type s to the left of the key type you want to specify from the displayed list of key types and press ENTER.

   Note: Although the IMP-PKA appears on this panel, it is not selectable on bipolar processors.

   In Figure 174 on page 189, the EXPORTER key is selected.

```
CSFCSE12 ---------- OS/390 ICSF - Key Type Selection Panel ----------  ROW 1 OF 6
COMMAND ===>                                                 SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
s  EXPORTER   Export key-encrypting key
   IMP-PKA    Limited authority importer key
   IMPORTER   Import key-encrypting key
   IPINENC    PIN-encryption input key-encrypting key
   NULL       Used to create CKDS entry
   OPINENC    PIN-encryption output key-encrypting key
   PINGEN     PIN generation key-encrypting key
   PINVER     PIN verification key-encrypting key
****************************** BOTTOM OF DATA ********************************
```

Figure 188. Selecting a Key Type on the Key Type Selection Panel

7. In the Key part field, enter FIRST for the first key part.

   Figure 189 on page 201 shows an example of the Operational Key Input panel filled in for a first key part.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'NICHOLS.HCRP210.CKDS'
Key label ==> EXPORTERATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> FIRST        FIRST, MIDDLE or FINAL
```

Figure 189. Specifying a First Key Part on the Operational Key Input Panel

8. When you have specified all the information, press ENTER.

   Since you are entering the first key part, the key label on the CKDS should not already exist. ICSF will create an entry with the key label you specify, and the Operational Key Input panel appears. See Figure 191 on page 202.

   However, if you specified a key label that already exists, the Operational Key Input panel appears. See Figure 190.

   Note: This panel appears only if the key represented by the existing label is a null key or a partial key. If the label represents a complete key, then an error message "NOT A PARTIAL KEY" will appear in the upper right corner of the panel.

```
CSFSCK40 -------------- OS/390 ICSF - Operational Key Input ----------------------
 COMMAND ===>

 A record with the following specifications has been found in the
selected CKDS:

  Key label  : EXPORTERATOB
  Key type   : EXPORTER









 Press ENTER to replace the existing record.
 Press END   to exit to the previous menu.
```

Figure 190. Operational Key Input Panel

This panel alerts you that even though you are entering the first key part, an entry in the CKDS under the label you specified already exists. The panel displays the key label and key type for the entry.

- If you want to replace the existing key with the new key that you are about to enter, press ENTER.

The new key value will replace the existing key under that label in the CKDS. The Operational Key Input panel appears. See Figure 191 on page 202.

- If you do not want to overwrite the existing key under this label, do the following:

  a. Press END.

     You return to the previous Operational Key Input panel, which is shown in Figure 189 on page 201.

  b. Specify a different key label that does not already exist and press ENTER.

     The Operational Key Input panel appears. See Figure 191. The operator key switch should be in the Normal position when this panel appears, and the KSU alphanumeric display will be blank.

```
CSFSCK20 -------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP1 using Brass Key #1.
```

Figure 191. Operational Key Input Panel

9. **At the KSU, insert brass key #1 into Key Switch 1 (Key Switch) and turn it to the Enter KP1 position.**

   To insert or remove the brass keys, the key switch must be in the Normal position. After you turn the switch to the **Enter KP1** position, `KP1` appears on the KSU alphanumeric display.

10. At the panel terminal, press ENTER to display status.

    The Operational Key Input panel appears. See Figure 192 on page 203.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                            KSU selected for new key         : 0
                            Current physical switch position : KP1
                            Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.




Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 192. Operational Key Input Panel

The current operator key switch position is Enter KP1, and the key part register status is enabled and empty.

If you are using the keypad, continue with "Using the Keypad to Enter Operational Key Parts Manually."

If you are using the hand-held KEU, continue with "Using the Hand-Held KEU to Enter Operational Key Parts Manually" on page 204.

Using the Keypad to Enter Operational Key Parts Manually

1. **At the KSU, press the Clear key.**

   This clears and turns on the KSU display screen.

2. **Press the Clear Entry key.**

   The cursor appears in the leftmost position of the Left Half Key (LHK) input area.

3. **Enter the 16 digits of the LHK.**

   An asterisk (*) appears for each digit you enter. When you have entered all 16 digits of the LHK, the cursor moves to the leftmost position of the Right Half Key (RHK) input area.

4. **Enter the 16 digits of the RHK.**

   Note: If you make a mistake when entering digits, press the Clear Entry key as many times as necessary to delete the incorrect digits from the display screen.

   After you enter the 16 digits of the RHK, the cursor moves to the leftmost position of the checksum (CkSum) input area.

5. **Enter the two-digit checksum.**

If the checksum you enter matches the checksum the ICRF calculates, you have entered the the key part correctly. The KSU displays the position of the operator key switch.

If the checksums do not match, the checksum field on the display screen is blanked out, and the message `Checksum Error` appears. If this occurs, follow this sequence to resolve the problem:

a. Reenter the checksum.

b. If you still get a checksum error, recalculate the checksum.

c. If your calculations result in a different value for the checksum, enter the new value.

d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

6. When you have entered the first key part successfully, continue with "Completing Manual Operational Key Part Entry" on page 205.

Using the Hand-Held KEU to Enter Operational Key Parts Manually

1. **Plug the hand-held KEU into the port on the KSU.**
2. **Press the CLR key.**

   This clears and turns on the KEU display screen.
3. **Press the CE key.**

   A red dot lights up next to the digit 0, indicating that the KEU is ready. The Key Entry Enabled light on the KSU lights if the KSU is able to accept the data.

   Note: If you do not press the CE key after the CLR key, the KEU display starts to flash after you enter the third digit. To clear this error condition, press the CLR and CE keys.
4. **Turn the rotary switch on the KSU to the Enter 1-16 position.**

   The KSU display should show `K`, indicating that the KSU is ready to start the key entry process. If any other message appears, refer to the KSU Display Message list in Figure 148 on page 166 for the meaning and action.
5. **Enter the 16 digits of the first key part.**

   As you enter each digit, it appears on the KEU alphanumeric display. The numbers 1 through 16 also appear in sequence on the KSU alphanumeric display. For example, when you enter the first digit, `K=01` appears on the KSU display.

   Note: If you make a mistake when entering digits, press the CE key as many times as necessary to delete the incorrect digits from the display screen.
6. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.**

   The KSU display should display `K`.
7. **Press the CLR and CE keys on the KEU.**
8. **Enter the last 16 digits of the key part.**

As you enter the digits, the digits display on the KEU alphanumeric display. The numbers 17 through 32 appear in sequence on the KSU alphanumeric display.

9. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.**

   The KSU display should show `K`.

10. **Press the CLR key and CE key on the KEU.**

11. **Enter the first digit of the two-digit checksum.**

    If you entered all 32 digits of the key part, the KSU display should show `K=C0`.

12. **Enter the second digit of the checksum.**

    The checksum verifies that you entered a key part correctly without accidentally transposing the digits or pressing the wrong digit on the KEU keypad.

    If the checksum you enter matches the checksum the ICRF calculates, you entered the key part correctly. The Key Entry Enabled light on the KSU turns off, and the KSU display shows the position of the operator key switch.

13. Continue with "Completing Manual Operational Key Part Entry."

Completing Manual Operational Key Part Entry

1. At the ICSF panel terminal, enter the verification pattern you calculated for the key part in the VP field of the Operational Key Input panel. This step is optional.

2. Press ENTER.

   If the verification pattern you entered matches the verification pattern the ICRF calculates, or if you did not enter a verification pattern, ICSF enciphers the key part under the appropriate master key variant and stores it in the CKDS.

   If the verification patterns do not match, the Operational Key Input panel appears. See Figure 193.

```
CSFSCK50--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

The verification patterns did not match.

  Entered verification pattern   : 5B280CD9E13C40B1
  Generated verification pattern : 80A21615D9E38C4B



  Add the key part to the CKDS?   ===>  NO       YES or NO



Type YES and press ENTER to add the record to the CKDS.
Press END to exit to the previous menu.
```

Figure 193. Operational Key Input Panel

The panel displays the two verification patterns so you can compare them.

3. Verify that the verification pattern you meant to enter is the same as the verification pattern you actually entered. If you did enter the verification pattern correctly, you may have made a mistake entering the key part.
4. Specify YES or NO to the question about adding the key part to the CKDS and press ENTER.

   The default response is NO. If you specify NO and press ENTER (or if you press END), you return to the Operational Key Input panel so that you can reenter the key part. See Figure 192 on page 203.

   If you specify YES in the field and press ENTER, ICSF enciphers the key part under the appropriate master key variant and adds the key part to the disk copy of the CKDS. You return to the previous panel shown in Figure 192 on page 203. The message CKDS UPDATED displays on that panel.
5. **At the KSU, rotate brass key #1 to the Normal position and remove it.**

You have completed the process to enter the first operational key part. ICSF has enciphered the key part you entered under the master key variant and stored it in the disk copy of the CKDS. When you complete the process to enter another key part, ICSF combines this key part with the first key part in the CKDS.

You are now ready to enter a middle or final key part.

- If you have middle key parts to load, continue with "Entering Middle Operational Key Parts Manually."
- If you want to enter a final key part, continue with "Entering the Final Operational Key Part Manually" on page 209.

Entering Middle Operational Key Parts Manually

If you want to enter more than two key parts, you must enter one or more intermediate key parts between entering the first key part and the final key part.

1. In the key part field on the Operational Key Input panel, specify MIDDLE, as shown in Figure 194, and press ENTER.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'NICHOLS.HCRP210.CKDS'
Key label ==> EXPORTERATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> MIDDLE       FIRST, MIDDLE or FINAL
```

Figure 194. Specifying a Middle Key Part on the Operational Key Input Panel

The Operational Key Input panel appears. See Figure 195 on page 207.

```
CSFSCK20 -------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP2 using Brass Key #2.
```

Figure 195. Operational Key Input Panel

2. **At the KSU, insert brass key #2 into Key Switch 2 (Key Switch) and turn the switch to the Enter KP2 position.**

   The KSU alphanumeric display shows KP2 after you turn the switch to the Enter KP2 position and the key part register is enabled.

3. At the panel terminal, press ENTER to display status.

   The Operational Key Input panel appears. See Figure 196.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                           KSU selected for new key         : 0
                           Current physical switch position : KP2
                           Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.



Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 196. Operational Key Input Panel

   The current physical switch position is Enter KP2. Because the key part register is now able to receive data but you have not yet entered an intermediate key part, the key part register status is ENABLED AND EMPTY.

4. **At the KSU, enter the middle key part by using the same steps as you did for the first key part.**

   Figure 197 presents the basic steps. For more detailed step-by-step instructions return to either “Using the Keypad to Enter Operational Key Parts Manually” on page 203 or “Using the Hand-Held KEU to Enter Operational Key Parts Manually” on page 204.

Figure 197. Basic Steps for Operational Key Using Keypad and Hand-Held KEU

Keypad	Hand-Held KEU
1. **Press the Clear key.** 2. **Press the Clear Entry key.** 3. **Enter the 16 digits of the LHK.** 4. **Enter the 16 digits of the RHK.** 5. **Enter the two-digit checksum.** If the checksum you enter matches the checksum the ICRF calculates, you have entered the key part correctly. The KSU displays the position of the operator key switch.	1. **Press the CLR key.** 2. **Press the CE key.** 3. **Turn the rotary switch on the KSU to the Enter 1-16 position.** 4. **Enter the 16 digits of the first key part.** 5. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.** 6. **Press the CLR and CE keys on the KEU.** 7. **Enter the last 16 digits of the key part.** 8. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.** 9. **Press the CLR key and CE key on the KEU.** 10. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The Key Entry Enabled light on the KSU turns off and the KSU display shows the position of the operator key switch.

5. At the ICSF panel terminal, enter the verification pattern you calculated for the key part in the VP field of the Operational Key Input panel. This step is optional.
6. Press ENTER.

   If the verification pattern you entered matches the verification pattern the ICRFcalculates, or if you did not enter a verification pattern, ICSF enciphers the key part under the appropriate master key variant and stores it in the CKDS.
7. If the verification patterns do not match, follow the steps in “Completing Manual Operational Key Part Entry” on page 205.

   Note: Do not switch the operator key switch position from the Enter KP2 position before you press ENTER, or the key part is lost.
8. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter a middle operational key part. If you have more middle key parts, repeat this task as many times as necessary.

After you enter all the middle key parts, enter the final key part as described in Entering the Final Operational Key Part Manually.

Entering the Final Operational Key Part Manually

To enter a final operational key part, follow these steps:

1. In the Key part field on the Operational Key Input panel, specify FINAL.

```
CSFSCK10 -------------- OS/390 ICSF - Operational Key Input ----------------------
COMMAND ===>

                         KSU selected for new key         : 0
                         Current physical switch position : NORMAL
                         Key part register status         : DISABLED AND EMPTY

Enter the data set name and the key specifications.

CKDS name ==> 'BURROUG.HCRP210.CKDS'
Key label ==> EXPORTATOB
Key type  ==> EXPORTER     Selection panel displayed if blank
Key part  ==> FINAL        FIRST, MIDDLE or FINAL

For FINAL key part enter the following information.

  Adjust parity      ===> YES          YES or NO
  Control Vector     ===> YES          YES or NO
  Installation data  ===> EXPORTER A TO B INSTALLED 07/01/97

Press ENTER to select the data set and the key.
Press END  to exit to the previous menu.
```

Figure 198. Operational Key Input Panel

2. In the Adjust parity field, specify YES if you want ICSF to adjust the parity to odd.

   Any key that ICSF generates has odd parity. However, ICSF allows you to enter a key with odd or can be odd, even, or mixed. We refer to even or mixed parity keys as non-odd parity keys. non-odd parity. A key with non-odd parity will function on ICSF, but ICSF will return an even parity reason code for many functions in which the key is used. Although ICSF runs with odd and non-odd parity, your installation may choose to run with just odd parity keys.

3. In the Control Vector field, specify YES or NO.

   For all types of keys except transport keys, specify YES. If you want to enter a transport key, you can specify either YES or NO. If you specify NO, ICSF flags the transport key for use in NOCV processing. In NOCV processing, ICSF uses the transport key itself rather than a transport key variant to encrypt keys. NOCV processing is used to exchange keys with products that do not use control vectors.

4. In the Installation data field, enter any information your installation wants to specify about the key.

   ICSF stores this information in the installation data field of the CKDS.

   Figure 198 shows this panel filled in for the final key part.

5. Press ENTER.

   The Operational Key Input panel appears. See Figure 199 on page 210.

```
CSFSCK20--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                          KSU selected for new key         : 0
                          Current physical switch position : NORMAL
                          Key part register status         : DISABLED AND EMPTY

Set the physical key switch to position KP2 using Brass Key #2.
```

Figure 199. Operational Key Input Panel

6. **At the KSU, insert brass key #2 into Key Switch 2 and turn the switch to the Enter KP2 position.**

   The KSU alphanumeric display shows KP2 after you turn the switch to the Enter KP2 position and the key part register is enabled.

7. At the panel terminal, press ENTER to display status.

   The Operational Key Input panel appears. See Figure 200.

```
CSFSCK30--------- OS/390 ICSF - Operational Key Input ---------------------
COMMAND ===>

                           KSU selected for new key         : 0
                           Current physical switch position : KP2
                           Key part register status         : ENABLED AND EMPTY

Enter a verification pattern. (optional)
  VP ===> 0000000000000000

If KSU 0 has a slot for a Personal Security Card, enter the
key part by inserting the card or by using the KSU keypad.

Otherwise, use a Key-Entry Unit (KEU), following these steps:

  1.  Plug in KEU, note light, clear KEU readout.
  2.  Turn rotary to 1-16: enter 16 hex digits.
  3.  Turn rotary to 17-32: enter 16 hex digits.
  4.  Turn rotary to CHECKSUM: enter 2 digit checksum.



Press ENTER after the key has been entered.
Press END   to exit to the previous menu.
```

Figure 200. Operational Key Input Panel

   The current physical switch position is Enter KP2. Because the key part register is now able to receive data but you have not yet entered a final key part, the key part register status is ENABLED AND EMPTY.

8. **At the KSU, enter the final key part by using the same steps as you did for the first key part.**

   Figure 201 presents the basic steps. For more detailed step-by-step instructions return to either “Using the Keypad to Enter Operational Key Parts Manually” on page 203 or “Using the Hand-Held KEU to Enter Operational Key Parts Manually” on page 204.

Figure 201. Basic Steps for Operational Key Using Keypad and Hand-Held KEU

Keypad	Hand-Held KEU
1. **Press the Clear key.** 2. **Press the Clear Entry key.** 3. **Enter the 16 digits of the LHK.** 4. **Enter the 16 digits of the RHK.** 5. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The KSU displays the position of the operator key switch.	1. **Press the CLR key.** 2. **Press the CE key.** 3. **Turn the rotary switch on the KSU to the Enter 1-16 position.** 4. **Enter the 16 digits of the first key part.** 5. **When you have entered all 16 digits of the first key half, turn the rotary switch to the Enter 17-32 position.** 6. **Press the CLR and CE keys on the KEU.** 7. **Enter the last 16 digits of the key part.** 8. **After you enter the last 16 digits, turn the rotary switch to the Checksum position.** 9. **Press the CLR key and CE key on the KEU.** 10. **Enter the two-digit checksum.** If the checksum you enter matches the checksum calculated by the ICRF, the key part has been entered correctly. The Key Entry Enabled light on the KSU turns off and the KSU display shows the position of the operator key switch.

Note: Do not switch the operator key switch position from the Enter KP2 position before you press ENTER, or the key part is lost.

9. **At the KSU, rotate brass key #2 to the Normal position and remove it.**

You have completed the process to enter the final operational key part.

After you enter the final key part, the key exists on the disk copy of the CKDS that you specified on the Operational Key Input panel. To make the key active, you replace the in-storage CKDS with the disk copy containing the key. To do this procedure, choose the REFRESH option in the KGUP panel path. The option exists on the Key Administration panel, which is shown in Figure 213 on page 248.

Note: Only complete keys, with a final key part entered, are read into storage during a refresh. When you refresh the CKDS, partial keys are not read into storage.

Chapter 8. Managing Cryptographic Keys by Using the Key Generator Utility Program

The key generator utility program (KGUP) generates and maintains keys in the cryptographic key data set (CKDS). The CKDS stores DATA keys, MAC keys, PIN keys, and transport keys. Although ANSI transport keys are stored in the CKDS, KGUP does not support the generation or import of ANSI transport keys. To run KGUP, ICSF must be active, it must contain a master key, and the CKDS must be initialized.

You use KGUP to perform the following tasks:

- Generate or enter keys
- Maintain CKDS entries by deleting or renaming the entries

When KGUP generates or receives a key value, the program either adds a new entry or updates an existing entry in the CKDS. For information about how KGUP generates and receives keys to establish key exchange with other systems, see “Using KGUP for Key Exchange” on page 216.

Each key that KGUP generates exists in the CKDS enciphered under your system's master key. Before the master key enciphers a key, the cryptographic facility exclusive ORs the master key with a pattern of characters called a control vector. A master key exclusive ORed with a control vector is called a master key variant.

A unique control vector exists for each type of key the master key enciphers. The cryptographic facility exclusive ORs the master key with the control vector associated with the type of key the master key will encipher. The control vector ensures that a key is only used in the cryptographic functions for which the key is intended. For example, the control vector for an input PIN encryption key ensures that such a key can be used only in PIN translate and PIN verification functions.

When you specify to KGUP to generate an input PIN-encrypting key, the cryptographic facility creates a master key variant for the key. The master key variant is a product of exclusive ORing the master key with the control vector associated with an input PIN-encrypting key. This master key variant enciphers the input PIN-encrypting key so the input PIN-encrypting key is in operational form. KGUP places the input PIN-encrypting key in a CKDS entry.

You use control statements to specify the functions for KGUP to perform. The control statement specifies the task you want KGUP to perform and information about the CKDS entry that is affected. For example, to have KGUP generate an importer key-encrypting key, you use a control statement like:

```
ADD  LABEL(KEY1)  TYPE(IMPORTER)
```

When KGUP processes the control statement, the program generates a key value and encrypts the value under a master key variant for an importer key-encrypting key. KGUP places the key in a CKDS entry labelled KEY1. The key type field of the entry specifies IMPORTER. For a description of the fields in a CKDS entry, see “Specifying KGUP Data Sets” on page 239.

You store the control statements in a data set. You must also specify other data sets that KGUP uses when the program processes control statements. You submit

a batch job stream to run KGUP. In the job control statements, you specify the names of the data sets that KGUP uses.

KGUP changes a disk copy of the CKDS according to the functions you specify with the control statements. After KGUP changes the disk copy of the CKDS, you may replace the in-storage copy of the CKDS with the disk copy using the ICSF panels.

To use KGUP, you must perform the following tasks:

- Create control statements
- Specify data sets
- Submit a job stream

You may also want to refresh the CKDS with the disk copy of the CKDS that KGUP updated. You can use the KGUP panels to help you perform these tasks. However you can also use KGUP without accessing the panels. This chapter first describes each of the tasks to run KGUP, and then describes how to use the panels to perform the tasks.

Disallowing Dynamic CKDS Updates During KGUP Updates

ICSF prioritizes changes to the CKDS sequentially, regardless of the source. A KGUP job does not have priority over application calls to the dynamic CKDS update services. Exclusive use of the CKDS by any one application call is minimal, however. For this reason, ICSF allows for a maximum concurrent usage of the CKDS by both KGUP and the dynamic update services.

Before you perform any function that affects the current CKDS (such as reenciphering, refreshing, or changing the master key), you should consider temporarily disallowing the dynamic CKDS update services.

If you are planning to use KGUP to make significant changes to the CKDS, you should disallow dynamic CKDS update. If an application tries to use the dynamic CKDS update services when they are disallowed, the return code indicates that the CKDS management service has been disabled by the system administrator.

To disallow dynamic CKDS access, perform the following tasks:

1. Choose option 7, the user control functions, on the Primary Menu Panel, as shown in Figure 202 on page 215.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility ---------
OPTION ===> 7

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User Control Functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 202. Selecting the User Control Option on the Primary Menu Panel

The User Control Functions panel appears. See Figure 203.

2. Select option 2 to disallow dynamic CKDS access.

```
CSFUFN00 --------------- OS/390 ICSF User Control Functions ---------------
COMMAND ===> 2

Enter the number of the desired option.
   Dynamic CKDS Access
   1  Allow
   2  Disallow

  PKA Callable Services
   3  Enable
   4  Disable

  PKDS Read Access
   5  Allow
   6  Disallow

  PKDS Write, Create and Delete Access
   7  Allow
   8  Disallow

Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 203. Selecting to Disallow Dynamic CKDS Access on User Control Functions Panel

3. Press ENTER.

   The message CKDS UPDATES DISABLED appears in the upper right-hand corner of the panel.

4. Press END to return to the Primary Menu panel.

Using KGUP for Key Exchange

KGUP generates keys that are complementary keys. Complementary keys have the same clear key value for corresponding key types. KGUP generates and maintains the following types of complementary keys:

- Data-encrypting (DATA) and data-translation (DATAXLAT) keys
- Importer key-encrypting key and exporter key-encrypting key
- Input PIN-encrypting key and output PIN-encrypting key
- MAC generation key and MAC verification key
- PIN generation key and PIN verification key

When you distribute keys or PINs, your system has one key, and the other system has the complementary key. For example, when your system sends a DATA key to another system, the importer and exporter key-encrypting keys at the systems complement each other. The DATA key is encrypted under an exporter key-encrypting key at your system. The DATA key is decrypted by the complementary importer key-encrypting key at the receiving system.

When KGUP generates a key, the other system involved in the key or PIN exchange needs the complement of the key. When KGUP generates a key, the program also generates a control statement to create the complement of the key. You send the control statement to the other system which uses the statement to create the complementary key.

For example, when you use KGUP to create an input PIN-encrypting key, KGUP also creates a control statement for the complementary output PIN-encrypting key. You send the control statement to another system. The other system uses the control statement to create the output PIN-encrypting key. Then your system can send PIN blocks to the other system.

For some key types you can choose the output key type by specifying the OUTTYPE parameter on a KGUP ADD or CREATE statement. For example, you can generate a DATA key for inclusion into the CKDS and export a copy of the key as either a DATA key or a DATAXLAT key. If you export the copy of the DATA key as a DATA key, the receiver of the key can use it to decipher data. If you export the copy of the DATA key as a DATAXLAT key, the receiver can use the key only to translate cipher text from one DATAXLAT key to another. The receiver of the DATAXLAT key cannot use the key to actually decipher the data.

KGUP stores the complementary key control statement in a data set. Because some cryptographic systems may not use KGUP control statements, KGUP also stores complementary key information as a record in a different data set. The information is not in the form of a control statement. You process and send the information to a system which creates the complementary key.

When KGUP generates a key, the program also generates information to create the complementary key. This information includes the complementary key value. The value is either a clear key value or encrypted key value. For an encrypted key value, the program encrypts the value under an exporter key. The importer key that complements this exporter key already exists at the other system. The importer key is one key in a complementary transport key pair that your system already established with the other system. The pair would be an importer key on the other system and an exporter key on your system. The other system reenciphers the

value from under the importer key to under its master key to generate the complementary key.

Besides generating keys and complementary key information, KGUP imports key values that are sent from other systems. The program can receive a control statement to create a key that is the complement of a key on another system. The key value your KGUP receives may be encrypted under a transport key. The transport key would be one key of a complementary transport key pair that you already established with the other system. The pair would be an exporter key on the other system and an importer key on your system. KGUP reenciphers the complementary key from under the importer key to under the master key and places the key in the CKDS.

For KGUP to send or receive keys in a key exchange with another system, the systems must previously establish a pair of complementary transport keys. For example, KGUP on one system defines the pair and generates the importer key in the clear. KGUP on the other system uses this value to define a pair of keys that are complements of the keys at the original site. For an example of how two ICSF systems establish pairs of complementary transport keys for key exchange, see “Scenario of Two ICSF Systems Establishing Initial Transport Keys” on page 272.

The cryptographic facility exclusive ORs a transport key with a control vector before using the transport key to encipher a key. A transport key exclusive ORed with a control vector is called a transport key variant. ICSF uses the control vector associated with the key type that the transport key will encipher. The control vector ensures that when another site imports the key, the resulting operational key can only be the type that the control vector indicates. For example, the control vector for a PIN verification key ensures that the system that receives the key can import the key only as a PIN verification key.

When KGUP generates a PIN generation key, the program generates a key value to create a PIN verification key. You can specify that the key value be an encrypted key value. When you do this, ICSF exclusive ORs the transport key with the control vector for a PIN verification key to create the transport key variant. Then the cryptographic facility enciphers the PIN verification key under the transport key variant.

To view the specific control vector value that is associated with each type of key to create master key variants and transport key variants, see Appendix A, Control Vector Table.

Transport key variants ensure that the receiving system uses the key as the type of key that the sending system intended. However transport key variants can only be used if both systems recognize transport key variants. You should use transport key variants when exchanging keys with the Transaction Security System (TSS) Products. However, systems with some cryptographic products, such as CUSP and PCF, do not recognize control vectors. When you exchange keys with such a system, a key that you send or receive is enciphered under a transport key rather than a transport key variant. You just specify to KGUP that the transport key should not be exclusive ORed with a control vector.

You can define a pair of complementary transport keys with another system so your system and the other system can exchange keys without control vectors. You use a control statement to indicate to KGUP to produce these keys. Then send the

clear value that KGUP produced to the CUSP or PCF system so the system can generate the corresponding complementary pair of keys. Then you use the transport keys to exchange other keys. Refer to “Scenario of an ICSF System and a CUSP or PCF System Establishing Initial Transport Keys” on page 273 for an example of how to establish pairs of complementary transport keys for key exchange between an ICSF system and either a CUSP system or PCF system.

You can also use KGUP to create complementary keys that are used by two different systems. Neither key would be operational on your system so KGUP would not update your CKDS. After KGUP generates the complementary key information, you send it to the two systems that need to share complementary keys.

Using KGUP Control Statements

You use control statements to specify the function you want the key generator utility program (KGUP) to perform. You use job control language (JCL) to submit the control statements to KGUP. You can create and submit KGUP control statements either on your own or using the KGUP panels.

You specify information to KGUP using an ADD, UPDATE, DELETE, RENAME or SET control statement. You use keywords on the control statement to specify:

- The function KGUP performs
- Information about the key that KGUP processes

For example, if you specify the KEY keyword on an ADD control statement, you supply a key which KGUP adds to the CKDS in an entry.

This topic describes the syntax of the control statements with their keywords. Use the following rules when interpreting the syntax of the control statements:

- Specify uppercase letters and special characters as shown in the examples.
- Lowercase letters represent keyword values that you must specify.
- A bar (|) indicates a choice (OR).
- Ellipses (...) indicates that multiple entries are possible.
- Braces ({ }) denote choices, one of which you must specify.
- Brackets ([ ]) denote choices, one of which you may specify.

General Rules for CKDS Records

There are some general rules for creating labels for CKDS key records.

- Each label can consist of up to 64 characters. The first character must be alphabetic or a national character (#, $, @). The remaining characters can be alphanumeric, a national character (#, $, @), or a period (.).
- Labels must be unique for DATA, DATAXLAT, MAC, MACVER, DATAM, DATAMV, and NULL keys.
- For compatibility with Version 1 Release 1 function, transport and PIN keys can have duplicate labels for different key types. Keys that you use the dynamic CKDS update services to create or update, however, must have unique key labels.
- Labels must be unique for any key record, including transport and PIN keys, created or updated using the dynamic CKDS update services.

KGUP and the dynamic CKDS update services, unless they are modified by user-written exits, check for uniqueness according to these rules before making any change to the CKDS.

KGUP Uniqueness Checking

KGUP first checks to see if the label in the control statement matches a label that already exists in the CKDS.

If KGUP is processing an ADD control statement and there is no matching record, KGUP continues processing. Also, if KGUP is processing a RENAME control statement and there is no match for the *new-label* parameter, KGUP continues processing the control statement. If KGUP finds a matching label, KGUP then checks whether the key requires a unique label. If the key does not require a unique label, KGUP continues processing the ADD or RENAME control statement. If the key does require a unique label, KGUP stops processing the control statement and issues a message.

If KGUP is processing an UPDATE or DELETE control statement and there is no matching record, KGUP ends processing and issues an error message. Also, if KGUP is processing a RENAME control statement and there is no match for the *old-label* parameter, KGUP ends processing and issues an error message. If KGUP finds a matching label, KGUP continues processing the UPDATE, DELETE, or RENAME control statement.

Dynamic CKDS Update Services Uniqueness Checking

The dynamic CKDS update services require unique record labels in the CKDS. Each service checks to see if the label in the application call matches a label that already exists in the CKDS. For the Key Record Create service, if there is no matching record in the CKDS, ICSF continues processing the application call. If there is a match, ICSF stops processing and returns a return code and reason code to the application. For the Key Record Write and Key Record Delete services, if there is only one record in the CKDS that matches the label in the application call, ICSF continues processing the application call. If there is more than one matching record in the CKDS, ICSF stops processing and returns a return code and reason code to the application.

Syntax of the ADD and UPDATE Control Statements

The ADD and UPDATE control statements use the same keywords. The ADD control statement adds new keys to the CKDS. UPDATE changes existing key entries. Use the ADD or UPDATE control statement to specify that KGUP generate a key value or import a key value that you provide.

Refer to Figure 204 on page 220 for the syntax of the ADD and UPDATE control statements.

```
{ADD | UPDATE}

  {LABEL(label1[,...,label64]) | RANGE(start-label,end-label)}

  TYPE(key-type)

  [OUTTYPE(key-type)]

  [TRANSKEY(key-label1[,key-label2]) | CLEAR]

  [NOCV]

  [LENGTH]

  [CDMF | DES]

  [KEY(key-value[,ikey-value])]
```

Figure 204. ADD and UPDATE Control Statement Syntax

LABEL (label1[,...,label64])

This keyword defines the names of the key entries for KGUP to process within the CKDS. KGUP processes a separate entry for each label. If you specify more than one label on an ADD or UPDATE control statement, the program uses identical key values in each entry.

You must specify at least one key label, and you can specify up to 64 labels with the LABEL keyword. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 218.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword. When you supply a key value on the control statement with the KEY keyword, you must specify the LABEL keyword.

RANGE (start-label, end-label)

This keyword defines the range of the multiple labels that you want KGUP to create or maintain within the CKDS.

The label consists of between 2 and 64 characters that are divided as follows:

- The first 1 to 63 characters are the label base. These characters must be identical on both the start-label and end-label and are repeated for each label in the range. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 218.
- The last 1 to 4 characters form the suffix. The number of digits in the start-label and end-label must be the same, and the characters must all be numeric. These numeric characters establish the range of labels KGUP creates. The start-label numeric value must be less than the end-label numeric value.

KGUP creates a separate CKDS entry for each label including the start and end labels. The program generates a different key value for each entry it creates.

You cannot use the RANGE keyword when you supply a key value to KGUP. Only use RANGE to generate a key value. The RANGE and KEY keywords are mutually exclusive.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword.

TYPE (key-type)

This keyword specifies the type of key you want KGUP to process. You can specify only one key type for each control statement. For DATA, DATAXLAT, MAC, MACVER, DATAM, DATAMV, and NULL key types, KGUP allows only one key per label. For all other key types, you can have keys with the same labels but different key types.

You can specify any of the following key types:

DATA	Encryption/decryption key
DATAXLAT	Cipher text translate key
DATAM	Double-length MAC generation key
DATAMV	Double-length MAC verification key
EXPORTER	Exporter key-encrypting key
IMPORTER	Importer key-encrypting key
IPINENC	Input PIN encryption key
MAC	Single-length MAC generation key
MACVER	Single-length MAC verification key
NULL	Used to create a null CKDS entry
OPINENC	Output PIN encryption key
PINGEN	PIN generation key
PINVER	PIN verification key

All these types of keys are stored in the CKDS.

Note: For compatibility with previous releases of OS/390 ICSF, KGUP stores internal versions of DATAM and DATAMV keys in the CKDS under the key types of MACD and MACVER, respectively.

OUTTYPE (key-type)

This keyword specifies the type of complementary key you want KGUP to generate for export. This keyword is valid only when you are requesting KGUP to generate keys and you also specify the CLEAR or TRANSKEY keywords. OUTTYPE is mutually exclusive with the KEY keyword. You cannot specify an OUTTYPE when you have chosen either DATAMV, PINVER, MACVER, or NULL for the key TYPE.

Refer to Figure 205 for a list of the default and optional complementary key types for each of the 11 different key types. If OUTTYPE is not specified, KGUP generates the default complementary key that is shown in this table.

Figure 205. Default and Optional OUTTYPES Allowed for Each Key TYPE

TYPE	OUTTYPE (Default)	OUTTYPE (Allowed)
DATA	DATA	DATA, DATAXLAT
DATAXLAT	DATAXLAT	DATAXLAT
DATAM	DATAMV	DATAM, DATAMV
DATAMV	Not Allowed	Not Allowed
EXPORTER	IMPORTER	IMPORTER
IMPORTER	EXPORTER	EXPORTER
IPINENC	OPINENC	OPINENC
MAC	MACVER	MAC, MACVER
MACVER	Not Allowed	Not Allowed
NULL	Not Allowed	Not Allowed
OPINENC	IPINENC	IPINENC
PINGEN	PINVER	PINVER
PINVER	Not Allowed	Not Allowed

TRANSKEY (key-label1[,key-label2])

This keyword identifies the label of a transport key that already exists in the CKDS. KGUP uses the transport key either to decrypt an imported key value or to encrypt a key value to send to another system.

When KGUP generates a key, the program enciphers the key under a master key variant. KGUP may also generate a key value that can be used to create the key's complement. You can have KGUP encrypt the key value under a transport key or transport key variant. On the control statement, use the TRANSKEY keyword to specify the transport key that KGUP should use to encipher the complementary key. You can send the encrypted key value to another system to create the complementary key.

When you generate an importer key-encrypting key to encipher a key stored with data in a file, you can request that KGUP not generate the complementary export key-encrypting key. You do this by not specifying the TRANSKEY or CLEAR keyword. This is also true for DATA and MAC keys.

When you input a key value that is in importable form, the key that is specified by the KEY keyword is enciphered under a transport key. KGUP reenciphers the key value from under the transport key to under a master key variant. On the control statement, you use the TRANSKEY keyword to specify the transport key that enciphers the key.

You can import or export a new version of a key that is encrypted under the current version of the same key. You can do this by specifying the same key label in the TRANSKEY keyword as in the LABEL or RANGE keyword on an UPDATE control statement.

Your site can generate keys for key exchange between two other sites. These sites do not need to know the clear value of the keys used for this communication. KGUP generates control statements that you send to the sites. Then the sites' KGUPs establish the keys they need for key exchange.

To do this procedure, submit an ADD or UPDATE control statement with two TRANSKEY key labels. The first TRANSKEY label identifies the transport key

that is valid between your site and the first recipient site. The second TRANSKEY label identifies the transport key that is valid between your site and the second recipient site. KGUP generates of a pair of control statements to create the complementary pair of keys that are needed at the two sites.

Note: You cannot specify two transport keys that were installed without control vectors. For more information about control vectors, see the description of the NOCV keyword.

The TRANSKEY keyword and the CLEAR keyword are mutually exclusive.

If you have specified a key type of NULL for the TYPE keyword, you cannot use the TRANSKEY keyword.

CLEAR

This keyword indicates that either:

- You are supplying an unencrypted key value with the KEY keyword.
- KGUP should create a control statement that generates an unencrypted complementary key value.

You can supply either encrypted or unencrypted key values to KGUP with the KEY keyword. On the control statement to supply the unencrypted key, you specify the CLEAR keyword.

When KGUP generates a key, KGUP enciphers the key under a master key variant. KGUP may also generate a key value to be used to create the key's complement. KGUP can create the complementary key value in unencrypted form. To generate an unencrypted complementary key value, you specify the CLEAR keyword. Your ICSF system must be in special secure mode to use this keyword.

The CLEAR keyword and the TRANSKEY keyword are mutually exclusive. You cannot use the CLEAR keyword on a control statement when you use the TRANSKEY keyword. You cannot use the CLEAR keyword if you specify a NULL key for the TYPE keyword.

NOCV

To exchange keys with systems that do not recognize transport key variants, ICSF provides a way to by-pass transport key variant processing. KGUP or an application program encrypts a key under the transport key itself not under the transport key variant. This is called NOCV processing.

The NOCV keyword indicates that the key that is generated or imported is a transport key to use in NOCV processing. The transport key has the NOCV flag set in the key control information when stored in the CKDS.

Note: To create keys for NOCV processing, NOCV-Enablement keys must exist. For a description of how to create NOCV-Enablement keys, see “Initializing the CKDS at First-Time Startup” on page 176.

The NOCV keyword is only valid for generating transport keys. The keyword is not valid if you specify the TRANSKEY keyword with two transport key labels.

LENGTH

LENGTH indicates the length of a DATA key to generate. LENGTH(8) generates a single-length key. LENGTH(16) generates a double-length key, and LENGTH(24) generates a triple-length key. LENGTH(24) applies only to DATA keys. It is no longer necessary to specify LENGTH when generating

MAC or MACVER keys, as these keys are now single-length only. If a LENGTH is specified for MAC or MACVER keys, however, it must be LENGTH(8). Similarly, it is not necessary to specify LENGTH when generating DATAM or DATAMV keys. However, if a LENGTH is specified when generating DATAM or DATAMV keys, it must be LENGTH(16).

For double-length key types, LENGTH(8) or SINGLE in an ADD or UPDATE statement causes KGUP to generate a double-length key with both halves the same. On the KGUP panel, you can achieve this by specifying 8 in the LENGTH field for a double-length key type.

In either case, LENGTH is used only for generating keys. If you are specifying clear or encrypted key parts, do not use the LENGTH keyword (and do not fill in a value for LENGTH on the KGUP panel).

The LENGTH keyword and KEY keyword are mutually exclusive. The LENGTH keyword is valid when you create control statements to generate DATA, MAC, MACVER, DATAM, or DATAMV keys. The LENGTH keyword is not necessary when generating MAC, MACVER, DATAM, or DATAMV keys. KGUP ignores the LENGTH keyword for DATAXLAT keys, which KGUP automatically generates as single-length keys.

CDMF

This keyword indicates that KGUP should generate, or you supply, a key marked for use in conjunction with the CDMF algorithm. A CDMF key, like a DES key, is a single-length (64-bit) key. This marks the key token that contains the CDMF key so that the use of the CDMF algorithm is automatically triggered. KGUP encrypts the key with a master key variant and stores the key in the CKDS. You can specify CDMF only with TYPE keywords DATA, IMPORTER, or EXPORTER. If you specify DATA, KGUP marks the DATA key for use in the CDMF algorithm, and LENGTH(8) is the only valid specification for LENGTH. If you specify IMPORTER or EXPORTER, KGUP marks the key to indicate that it will transport DATA keys that are intended for use in the CDMF algorithm.

The CDMF and DES keywords are mutually exclusive.

DES

This keyword indicates that KGUP should generate, or you supply, a key marked for use with the DES algorithm. A DES key is a single-length (64-bit) key. This marks the key token that contains the DES key so that the use of the DES algorithm is automatically triggered. KGUP encrypts the key with a master key variant and stores the key in the CKDS. You can specify DES only with TYPE keywords DATA, IMPORTER, or EXPORTER. If you specify DATA, KGUP marks the DATA key for use in the DES algorithm. If you specify IMPORTER or EXPORTER, KGUP marks the key to indicate that it will transport DATA keys that are intended for use in the DES algorithm.

The DES and CDMF keywords are mutually exclusive.

KEY (key-value[,ikey-value])

This keyword allows you to supply KGUP with a key value. KGUP can use this key value to add a key or update a key entry.

This keyword is required when you specify either DATAMV, MACVER, or PINVER for the TYPE keyword. Because KGUP cannot generate PIN verification or MAC verification keys in operational form, you must always supply values for these types of keys.

When you enter a double-length key, you enter the key in two parts. Each key part consists of exactly 16 characters that represent 8 hexadecimal values. These parts are:

- The *key-value*, the first part, or left half of the key
- The *ikey-value*, the second part, or right key half is also known as the intermediate key value

When you are adding a DATA key, you can add the key in one, two, or three parts.

KGUP links the two values to form a full double-length key.

To supply an effectively single-length key to KGUP, only specify one key-value on the KEY keyword. KGUP duplicates this value to create an identical intermediate key value. KGUP concatenates these two identical values, and then stores and uses the key as if the key was double-length. If you do not specify this keyword, KGUP generates the key value for you.

Because DATAXLAT is a single-length key, you cannot supply a second key value for this key type. If you supply an ikey-value for a DATAXLAT key, KGUP discontinues processing the control statement and issues an error message.

For double-length keys, when you use the TRANSKEY keyword with the KEY keyword, the transport key you specify is the importer key that encrypts the key value. If you supply only one key value for a double-length key and also specify TRANSKEY, the TRANSKEY must be an NOCV importer. You cannot use the RANGE keyword or the LENGTH keyword the RANGE or LENGTH keyword with this keyword.

Attention: NOCV processing takes place automatically when KGUP or an application specifies the use of a transport key that was generated by KGUP with a NOCV keyword specified.

The use of NOCV processing eliminates the ability of the system that generates the key to determine the use of the key on a receiving system. Therefore, access to these keys should be strictly controlled. For a description of security considerations, see the *OS/390 ICSF System Programmer's Guide*.

Using the ADD and UPDATE Control Statements for Key Management and Distribution Functions

You use the ADD and UPDATE control statements to run KGUP for functions that involve key generation, maintenance, and distribution. For ADD and UPDATE control statements, KGUP either imports a key value that you supply or generates a key value. This section describes the combinations of control statement keywords you use to perform these functions. Figure 206 shows the keyword combinations permitted on ADD and UPDATE control statements.

Figure 206. Keyword Combinations Permitted in ADD and UPDATE Control Statements

Control Statement	LABEL or RANGE	TYPE	OUTTYPE	TRANSKEY or CLEAR	NOCV	CDMF or DES	LENGTH or KEY
ADD	Yes	Yes	Yes[1]	Yes[2]	Yes[3]	Yes[4]	Yes[1]
UPDATE	Yes	Yes	Yes[1]	Yes[2]	Yes[3]	Yes[4]	Yes[1]

Note:

1. OUTTYPE can be used with either TRANSKEY or CLEAR but is mutually exclusive with KEY.
2. TRANSKEY is not valid when TYPE is NULL.
3. NOCV is not valid when TRANSKEY is specified with two key labels.
4. The DES or CDMF keywords can only be used with TYPE of DATA, EXPORTER, or IMPORTER and can be used only on the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise.

To Import Keys

You use an ADD or UPDATE control statement to supply a value to KGUP. The program receives the value, enciphers the value under a master key variant, and places the value in a CKDS entry. The value that you supply may be in clear form or it may be encrypted under a transport key. The statement that contains the value may be sent from another system. The other system sends the value to create a key on your system. This key is the complement of a key that was generated on the other system.

You can supply a transport key value to KGUP from a system that does not use control vectors. You use the key for key exchange with that system. KGUP places the key into the CKDS with an indication that the key is to be used without control vectors.

Note: If you are sharing a CKDS between OS/390 ICSF and any release of ICSF/MVS Version 1, you should use caution. New key types introduced in ICSF Version 2 Release 1 (the level of ICSF in OS/390 V2R5) and the CDMF/DES key token markings will result in an error if used on the ICSF/MVS Version 1 product.

Import a Clear Key Value: You can supply a clear key value on a control statement for KGUP to import.

The following statements show the syntax when you supply a clear key value to KGUP.

Note: For these control statements, your system should be in special secure mode.

When you supply a single-length, clear key value:

```
ADD or UPDATE  LABEL(label)    TYPE(data,dataxlat,exporter,importer,
mac,macver, or any PIN key)  CLEAR  KEY(key-value)
```

When you supply a double-length, clear key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,datam,datamv,exporter,importer,
or any PIN key)  CLEAR  KEY(key-value,ikey-value)
```

When you supply a triple-length, clear key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data)
CLEAR  KEY(key-value, key-value, key-value)
```

When you supply a single-length clear key value and you use the key to exchange keys with a cryptographic product that does not use control vectors or double-length keys:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer)
CLEAR  KEY(key-value)  NOCV
```

When you supply a double-length, clear key value, and you use the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer)
CLEAR  KEY(key-value,ikey-value)  NOCV
```

When you supply a single-length, clear key value, and you use the key to exchange data with a CDMF-only system:

```
ADD or UPDATE  LABEL(label)  TYPE(data, exporter or importer)
CLEAR  KEY(key-value)  CDMF
```

Import an Encrypted Key Value: When you supply KGUP with an encrypted key value, the value is encrypted under a transport key. The transport key is one key in a complementary key pair that you share with another system. When the other system's KGUP generated a key, the program also stored a control statement to use to create the complementary key. The other system sends the control statement to your system. You can use the statement to supply an encrypted key value to KGUP to create the key.

The following statements show the syntax when you supply an encrypted key value to KGUP.

When you supply a single-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,dataxlat,exporter,importer,
mac,macver, or any PIN key) TRANSKEY(key-label 1)  KEY(key-value)
```

When you supply a double-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,datam,datamv,exporter,importer,
or any PIN key) TRANSKEY(key-label 1)  KEY(key-value,ikey-value)
```

When you supply a triple-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data)
TRANSKEY(key-label 1)  KEY(key-value, key-value, key-value)
```

When you supply a single-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors or double-length keys:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer)
TRANSKEY(key-label 1)  KEY(key-value)  NOCV
```

Note: Single-length keys with replicated key parts can be brought in under a TRANSKEY only if the TRANSKEY is an NOCV IMPORTER.

When you supply a double-length encrypted key value and you will use the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer)
TRANSKEY(key-label 1)  KEY(key-value,ikey-value)  NOCV
```

When you supply a single-length, encrypted key value, and you are using the key to exchange data or keys with a CDMF system:

```
ADD or UPDATE  LABEL(label)  TYPE(data, exporter, or importer)
TRANSKEY(key-label 1)  KEY(key-value)  CDMF
```

To Generate Keys

You use an ADD or UPDATE control statement to have KGUP generate a key value to place in the CKDS. The program generates the value, enciphers the value under a master key variant, and places the value in the CKDS. When KGUP generates a key, the program may also store information to create the key's complement in a data set.

You can have KGUP generate a transport key that you use to send or receive keys from a system that does not use control vectors. KGUP places the key into the CKDS with an indication that the key is to be used without control vectors.

Generate an Importer Key For File Encryption: You can have KGUP create an importer key without having KGUP store information about the complement of the key. You do not use the importer key in key exchange with another system. You use the importer key to encrypt a data-encrypting key that you use to encrypt data in a file on your system. You can store the data-encrypting key with the file, because the data-encrypting key is encrypted under the importer key.

The following statements show the syntax when you generate an importer key to use in file encryption on a system:

When you generate a single-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(importer)  SINGLE
```

When you generate a double-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(importer)
```

When you generate a key to import a data-encrypting intended for use in the CDMF algorithm:

```
ADD or UPDATE  LABEL(label)  TYPE(importer)  CDMF
```

Generate a Complementary, Clear Key Value: You can have KGUP store complementary key information when KGUP generates a key. This information includes the key value. You send the information to another system which uses the information to generate the complementary key. KGUP stores the key value to create the complementary key in either clear or encrypted form. KGUP stores information both in and not in the form of a control statement.

The following statements show the syntax when you have KGUP store the complementary key value in clear form.

Note: For these control statements, your system should be in special secure mode.

When you generate a single-length, transport or PIN clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen) CLEAR  SINGLE
```

When you generate a single-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(8) CLEAR
```

When you generate a double-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(16) CLEAR
```

When you generate a triple-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(24) CLEAR
```

When you generate a single-length, MAC clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(mac) OUTTYPE(mac or macver) CLEAR
```

When you generate a double-length, DATAM clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(datam) LENGTH(16) OUTTYPE(datam or datamv) CLEAR
```

When you generate a single-length, DATAXLAT clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(dataxlat) CLEAR
```

When you generate a double-length, clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen) CLEAR
```

When you generate a single-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter or importer)  CLEAR  NOCV  SINGLE
```

When you generate a double-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(16) CLEAR NOCV
```

When you generate a triple-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(24)  CLEAR  NOCV
```

When you generate a double-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter or importer)  CLEAR  NOCV
```

When you generate a clear key value to transport data-encrypting keys for use in the DES algorithm:

```
ADD or UPDATE LABEL(label) TYPE(exporter or importer) CLEAR DES
```

Generate a Complementary, Encrypted Key Value: KGUP encrypts the complementary key value under the exporter key that you specify.

The following statements show the syntax when you have KGUP generate the complementary key value in encrypted form.

When you generate a single-length, transport or PIN encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen)
TRANSKEY(key-label 1)  SINGLE
```

When you generate a single-length, DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) OUTTYPE(data or dataxlat) TRANSKEY(key-label 1)
```

When you generate a single-length, MAC encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(mac) OUTTYPE(mac or macver) TRANSKEY(key-label 1)
```

When you generate a single-length, DATAXLAT encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(dataxlat) TRANSKEY(key-label 1)
```

When you generate a double-length, encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen)  TRANSKEY(key-label 1)
```

When you generate a double-length DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data or datam)  LENGTH(16) TRANSKEY(key-label 1)
```

When you generate a double-length DATAM encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(datam)  TRANSKEY(key-label 1)
```

When you generate a triple-length DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data)  LENGTH(24) TRANSKEY(key-label 1)
```

When you generate a single-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter or importer)  TRANSKEY(key-label 1)  SINGLE  NOCV
```

When you generate a double-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors.

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter or importer)  TRANSKEY(key-label 1)  NOCV
```

When you generate a double-length, encrypted key value that is marked to indicate that it will transport data-encrypting keys that are intended for use in the CDMF algorithm:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter or importer) TRANSKEY(key-label 1) CDMF
```

Generate a Complementary Key Pair For Other Systems: You can also use KGUP as a key distribution center. KGUP generates a pair of complementary key values that are both used on other systems. KGUP encrypts the values under appropriate variants of two different exporter key-encrypting keys. KGUP does not alter your system's CKDS. The program stores two control statements each containing one of the keys that are encrypted under a transport key. You send the statements to two other sites which can create the keys and use the keys to exchange keys.

The following statements show the syntax when you have KGUP generate a pair of complementary key values to send to other systems.

When you generate single-length transport or PIN key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen)
TRANSKEY(key-label 1,key-label 2)  SINGLE
```

When you generate single-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) OUTTYPE(data or dataxlat) TRANSKEY(key-label 1,
key-label 2)
```

When you generate double-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(16) TRANSKEY(key-label 1,key-label 2)
```

When you generate triple-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data) LENGTH(24) TRANSKEY(key-label 1,key-label 2)
```

When you generate single-length MAC key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(mac) OUTTYPE(mac or macver) TRANSKEY(key-label 1,
key-label 2)
```

When you generate double-length DATAM key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(datam) OUTTYPE(datam or datamv)
TRANSKEY(key-label 1,key-label 2)
```

When you generate single-length DATAXLAT key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(dataxlat) TRANSKEY(key-label 1,key-label 2)
```

When you generate a double-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(exporter,importer,ipinenc,opinenc, or pingen)
TRANSKEY(key-label 1,key-label2)
```

To Create NULL Keys

You can use KGUP to create an initial record in the CKDS. To do this, you create an ADD control statement with a key TYPE of NULL. Once you have created this key record, you can use the Key Record Write callable service to place a key value in the record.

If you are generating a large number of keys, you will get better performance if you create the NULL key records with KGUP. This is preferrable to using the Key_Record_Create callable service.

Create NULL Key Records: You can use KGUP to create a single NULL key record or a range of NULL key records. The following statement shows the syntax you use:

```
ADD  LABEL(label) or RANGE(start-label,end-label)  TYPE(null)
```

Syntax of the RENAME Control Statement

The RENAME control statement changes the label of a key entry in the CKDS. KGUP does not change any other information in the entry.

The RENAME control statement has the following syntax:

Figure 207. RENAME Control Statement Syntax

LABEL(old-label,new-label)
This keyword specifies the labels of the CKDS entries that you want KGUP to process. For the general rules about key label conventions and uniqueness, see “General Rules for CKDS Records” on page 218.

First you specify the old label which is the current label in the CKDS that KGUP changes. Then you specify the new label to replace the old label.

TYPE(key-type)
Because you can use the same label in entries with different key types, this keyword specifies the type of key for the old entry and the new entry.

Syntax of the DELETE Control Statement

DELETE control statements instruct KGUP to remove key entries from the CKDS.

The DELETE control statement has the following syntax:

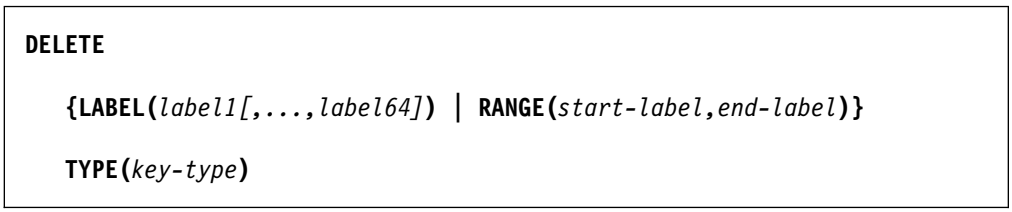

Figure 208. DELETE Control Statement Syntax

LABEL (label1[,...,label64])
This keyword defines the names of the key entries for KGUP to delete from the CKDS. KGUP deletes a separate entry for each label.

You must specify at least one key label, and you can specify up to 64 labels with the LABEL keyword. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 218.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword.

RANGE (start-label, end-label)
This keyword defines the range of the multiple labels that you want KGUP to delete from the CKDS.

The label consists of between 2 and 64 characters that are divided as follows:

- The first 1 to 63 characters are the label base. These characters must be identical on both the start-label and end-label and are repeated for each label in the range. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 218.
- The last 1 to 4 characters form the suffix. The number of digits in the start-label and end-label must be the same, and the characters must all be numeric. These numeric characters establish the range of labels KGUP creates. The start-label numeric value must be less than the end-label numeric value.

TYPE(key-type)
Because you can use the same label in entries with different key types, this keyword specifies the type of key that is being deleted.

To Delete Keys

You can use a KGUP control statement to remove a key or a range of keys from the CKDS. The following statement shows the syntax when you delete keys from the CKDS:

```
DELETE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data,dataxlat,exporter,importer,ipinenc,mac,macver,
null,opinenc,pingen, or pinver)
```

Syntax of the SET Control Statement

The SET control statement specifies data you want KGUP to pass to the installation-defined exit routine for processing.

The SET control statement has the following syntax:

Figure 209. SET Control Statement Syntax

INSTDATA(data-value)
This keyword specifies the data KGUP sends to the KGUP exit routine while processing control statements.

During a KGUP job, the data you specify with the INSTDATA keyword is held and sent to the exit routine each time the exit is entered for control statement processing. The same information is sent until KGUP encounters another SET control statement. The data you specified in this SET control statement replaces the data you specified in the previous SET control statement.

A KGUP exit routine performs different operations that depend on the data that is sent and the time of the call. A KGUP exit routine can change the data you send the exit and send the changed data to the user area of a key entry in the CKDS. The user area of a key entry can contain any information that you choose to store in the area.

For more information about the KGUP exit routine, see the *OS/390 ICSF System Programmer's Guide*.

The maximum length of the character string that you can specify to an exit routine is 52 bytes. If you use blanks or special characters within the string, then you must delimit the entire string with single quotes ('). These quotes are not included as part of the 52-byte string.

Examples of Control Statements

Example 1: ADD Control Statement

This example shows a control statement that specifies that KGUP add an entry to the CKDS.

```
ADD  TYPE(IMPORTER) LABEL(DASDOCT93401E)
```

KGUP checks that an entry labeled `DASDOCT93401E` with a keytype of importer does not already exist in the CKDS. It also checks that there are no DATA, DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the key entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of `DASDOCT93401E` and type of IMPORTER. KGUP generates a double-length key and encrypts the key under the master key variant for an importer key. KGUP places the key in the entry.

Note: Because neither the TRANSKEY nor CLEAR keyword is specified, KGUP does not create a complementary key. You cannot use this key to communicate with another system. You can, however, use the key to encipher a key stored with data in a file. IMPORTER, DATA, DATAM, and MAC are the only key types that do not require either the TRANSKEY or CLEAR keyword specified.

Example 2: ADD Control Statement with CLEAR Keyword

This example shows a control statement that specifies that KGUP add an entry to the CKDS. Because the CLEAR keyword is specified, KGUP processes only this control statement if ICSF is in special secure mode.

```
ADD  TYPE(EXPORTER)  LABEL(ATMBRANCH5MO001)  CLEAR
```

KGUP checks that an entry with the label ATMBRANCH5MO001 with the type EXPORTER does not already exist in the CKDS. It also checks that there are no DATA, DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry for the label specified and the type exporter. KGUP generates a double-length key, encrypts the key under the master key variant for an exporter key, and places the key in the entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complements of the keys you created. The information contains the clear key value and specifies the key type as importer.

KGUP also stores a control statement to the control statement output data set. You can send this control statement to another system. The other system's KGUP uses the control statement to create a key that complements the key that you just created.

For example, the control statement would be in the following format:

```
ADD  TYPE(IMPORTER)  LABEL(ATMBRANCH5MO001)  CLEAR,
KEY(6709E5593933DA00,9099937DDE93A944)
```

The key value is the clear key value of the key created. The type of key is the complement of the type of key created.

Note: The key in the above example is a mixed parity key. KGUP imports mixed parity keys, but issues a warning message.

Example 3: ADD Control Statement with one TRANSKEY Keyword

This example shows a control statement that specifies that KGUP add an entry to the CKDS. Because the TRANSKEY keyword is specified, KGUP also creates a control statement that another installation uses to create the complement of the key for PIN exchange.

```
ADD  TYPE(IPINENC)  LABEL(LOCTOJWL.JUNE99)  TRANSKEY(SENDJWL.JUNE99)
```

KGUP checks that an entry with the label LOCTOJWL.JUNE99 for an input PIN-encrypting key does not already exist in the CKDS. It also checks that there are no DATA, DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of LOCTOJWL.JUNE99 and type of IPINENC. KGUP generates a double-length key. KGUP encrypts the key under the master key variant for an input PIN-encrypting key and places the key in the entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complement of the key you created. The information contains the key in exportable form. The key is encrypted under the exporter key, labelled SENDJWL.JUNE99, that was specified by the TRANSKEY keyword. The information specifies the key type as output PIN-encrypting key (OPINENC).

Note: If SENDJWL.JUNE99 is an NOCV exporter, the exportable OPINENC key is encrypted without a control vector.

KGUP stores a control statement to the control statement output data set. You can send the control statement to another system. The other system's KGUP uses the statement to create a key that complements the key that you created.

For example, the control statement would be in the following format:

```
ADD  TYPE(OPINENC)  LABEL(LOCTOJWL.JUNE99)  TRANSKEY(SENDJWL.JUNE99),
KEY(6709E5593933DA00,9099937DDE93A944)
```

The key value is the encrypted value of the key that KGUP created. The key is encrypted under the exporter key, labeled SENDJWL.JUNE99, which was the transport key label that was specified on the original control statement. The type of key is the complement of the type of key it created.

Example 4: ADD Control Statement with two TRANSKEY Keywords

This example shows a control statement specifying that KGUP create keys for key exchange between two other sites.

```
ADD  TYPE(EXPORTER)  LABEL(JWL@SSIJUNE99)
TRANSKEY(SENDTOJWLJUNE99,SENDTOSIIJUNE99)
```

KGUP generates a key value and encrypts the value under the variants of the exporter key-encrypting keys that are specified by the TRANSKEY keyword. KGUP does not alter the CKDS in any way.

KGUP stores the following two control statements to the control statement output data set:

```
ADD  TYPE(EXPORTER)  LABEL(JWL@SSIJUNE99)  TRANSKEY(SENDTOJWLJUNE99),
KEY(4542E37B570033AD,3C00F6850A99E11B)

ADD  TYPE(IMPORTER)  LABEL(JWL@SSIJUNE99)  TRANSKEY(SENDTOSIIJUNE99),
KEY(6709E5993933DA00,1449A3D9ED0A1586)
```

The control statements create keys that complement each other. You send the statements to two sites that want to exchange keys. The receiving sites process the statements to create a complementary pair of transport keys.

KGUP also stores information to create the keys in the key output data set.

Example 5: ADD Control Statement with a Range of NULL Keys

This example shows a control statement that creates a range of empty key records in a CKDS. Once the key labels exist, you can enter key types and key values for these records in several ways. One method is to use KGUP to create UPDATE control statements. Another method is to write application programs that use the Key_Record_Write callable service to add key types and key values to the existing empty key records.

```
ADD  TYPE(NULL)  RANGE(BRANCH5M0001,BRANCH5M0025)
```

KGUP checks for any entries with labels between BRANCH5M001 and BRANCH5M0025 in the CKDS. If any entries in this range already exist, KGUP processes the control statement up to the point where a duplicate label is found. It then stops processing the control statement and issues error messages.

If no entries exist, KGUP creates a range of 25 sequentially-numbered key records and adds them to the CKDS.

Example 6: ADD Control Statement with OUTTYPE and TRANSKEY Keywords

This example shows a control statement that specifies that KGUP add an entry with the key type of DATA to the CKDS. The TRANSKEY keyword instructs KGUP to create a control statement for an intermediate node to use to create the complement DATAXLAT key for intermediate node data translation.

```
ADD  LABEL(DATAKEY.TO.TRANSLATION)  TYPE(DATA)  OUTTYPE(DATAXLAT)
TRANSKEY(TKBRANCH2.INTER)
```

KGUP checks that an entry withthe label DATAKEY.TO.TRANSLATION does not already exist in the CKDS, because DATA keys require unique labels. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of DATAKEY.TO.TRANSLATION and a type of DATA. KGUP then generates a single-length key, encrypts the key under the master key variant for a DATA key, and places the key in the CKDS entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complement of the key you created. The information contains the key value of the key in exportable form. The key is encrypted under the exporter key, labeled TKBRANCH2.INTER, that was specified by the TRANSKEY keyword. The information specifies the key type as data-translation key (DATAXLAT).

KGUP stores a control statement to the control statement output data set. You can send the control statement to another system. The other system's KGUP uses the statement to create a key that complements the key you created.

For example, the control statement would be in the following format:

```
ADD  TYPE(DATAXLAT)  LABEL(DATAKEY.TO.TRANSLATION)
TRANSKEY(TKBRANCH2.INTER), KEY(2509F2869257BD00)
```

The key value is the encrypted value of the key that KGUP created. The key is encrypted under the exporter key, labelled TKBRANCH2.INTER, which was the

transport key label that was specified on the original control statement. The type of key is the complement of the type of key it created.

Example 7: ADD Control Statement for a CDMF Key

This example shows a control statement that specifies that KGUP should add an entry to the CKDS and mark it as a CDMF key.

```
ADD  TYPE(DATA) LABEL(COMKEY26596E) CDMF
```

KGUP checks that an entry with the label COMKEY26596E with a key type of data does not already exist in the CKDS. It also checks that there are no DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label (because each of these keys requires a unique label). If the key entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of COMKEY26596E and type of DATA. KGUP marks the key token to indicate that the key is to be used in the CDMF algorithm. KGUP generates a single-length key and encrypts the key under the master key variant for a data key. KGUP places the key in the entry.

Note: Because neither the TRANSKEY nor CLEAR keyword is specified, KGUP does not create a complementary key. You cannot use this key to communicate with another system. You can, however, use the key to encipher a key stored with data in a file. IMPORTER, DATA, DATAM, and MAC are the only key types that do not require either the TRANSKEY or CLEAR keyword specified.

Example 8: UPDATE Control Statement with Key Value and Transkey Keywords

This example shows a control statement that specifies that KGUP import a key value. KGUP places the key value into an entry in the CKDS that already exists.

```
UPDATE  LABEL(PINVBRANCH5M0002)  TYPE(PINVER)  TRANSKEY(TKBRANCH5JUNE99)
KEY(7165865940460A48,2237451B4545718B)
```

The key value on the control statement is encrypted under a transport key that is shared with another system. The label for the transport key is TKBRANCH5JUNE99. KGUP uses the importer key labelled TKBRANCH5JUNE99 to decrypt the key value.

KGUP encrypts the key value under the master key variant for a PIN verification key. KGUP then places the key in a key entry labelled PINVBRANCH5M0002 with the type PINVER in the CKDS.

Example 9: DELETE Control Statement

This example shows a control statement that specifies that KGUP delete an entry from the CKDS.

```
DELETE  LABEL(GENBRANCH2M0003)  TYPE(PINGEN)
```

KGUP deletes the entry with a label of GENBRANCH2M0003 and type of PIN generation key from the CKDS. If KGUP cannot find the entry, KGUP gives you an error message.

Example 10: RENAME Control Statement

This example shows a control statement that specifies that KGUP rename an entry in the CKDS.

```
RENAME  LABEL(JWL@SSIDEC97,JWL@SSIJUNE99)  TYPE(EXPORTER)
```

KGUP checks if an entry with a label of JWL@SSIJUNE99 and a key type of EXPORTER already exists in the CKDS. If the entry does exist, KGUP does not process the control statement. KGUP checks if an entry with the label JWL@SSIDEC97 contains a key type of EXPORTER exists. If the entry exists, KGUP renames the entry JWL@SSIJUNE99.

Example 11: SET Control Statement

This example shows a control statement that specifies that KGUP send certain installation data every time an exit is called during KGUP processing. KGUP sends the data every time an exit is called until KGUP encounters another SET statement or the job stream completes.

```
SET  INSTDATA('This key is valid effective 9/9/99')
```

KGUP sends the installation data each time an installation exit is called during KGUP processing.

Specifying KGUP Data Sets

During key generator utility program (KGUP) processing, you store the information you supply and receive in the following data sets:

- The cryptographic key data set (CKDS) contains key entries that you have KGUP add, update, rename, or delete.
- The control statement input data set contains the control statements that specify the functions you want KGUP to perform.
- The diagnostics data set contains information you can use to check that the control statement succeeded.
- The key output data set contains information that another system uses to create keys that are complements of keys on your system.
- The control statement data set contains control statements that another system uses to create keys that are complements of keys on your system.

You specify the names of the data sets in the job control language to submit the job.

The following sections describe the data sets that KGUP accesses or generates in detail.

Cryptographic Key Data Set (CKDS)

This VSAM key sequenced data set contains the cryptographic keys for a particular KGUP job. It has a fixed logical record length (LRECL) of 252 bytes.

Programming Interface information

The records in the CKDS are in the following format:

Key label (Character length 64 bytes) The key label specified on the control statement.

Key type (Character length 8 bytes) The key type specified on the control statement.

Creation date (Character length 8 bytes) The initial date the record was created, in the format YYYYMMDD.

Creation time (Character length 8 bytes) The initial time the record was created, in the format HHMMSSTH.

Last update date (Character length 8 bytes) The most recent date the record was updated, in the format YYYYMMDD.

Last update time (Character length 8 bytes) The most recent time the record was updated, in the format HHMMSSTH.

Key token (Character length 64 bytes) A key token is composed of the key value and control information. The master key encrypts the key value in this field. For a description of format of a key token, see the *OS/390 ICSF System Programmer's Guide* .

CKDS flag bytes (Bit length 2 bytes) If bit zero is set to one, the key within the token is a partial key. All the other bits are reserved.

Reserved (Character length 26 bytes) Reserved. This field contains binary zeros.

Installation Data (Character length 52 bytes) Using the KGUP exit, conversion program exit, or single-record, single-record, read-write exit, you can place information associated with the key entry into this field.

Authentication code
(Character length 4 bytes) The message authentication code computed on the previous fields of the record using a system key that is a MAC generation key. ICSF uses the code to verify the record when the record is updated.

The first record in the CKDS is a header record. The header record in the CKDS is in the following format:

Key label (Character length 64 bytes) Binary zeros. This field is not to be used.

Key type (Character length 8 bytes) Binary zeros. This field is not to be used.

Creation date (Character length 8 bytes) The initial date the record was created, in the format YYYYMMDD.

Creation time (Character length 8 bytes) The initial time the record was created, in the format HHMMSSTH.

Last update date (Character length 8 bytes) The most recent date the record was updated, in the format YYYYMMDD.

Last update time (Character length 8 bytes) The most recent time the record was updated, in the format HHMMSSTH.

Sequence number (Character length 2 bytes) Initially binary zero, incremented each time the data set is processed.

CKDS header flag bytes
(Bit length 2 bytes) If bit zero is set to one, the master key verification pattern is valid. If bit one is set to one, the master key authentication pattern is valid. All the other bits are reserved.

Master key verification pattern
(Character length 8 bytes) The system master key verification pattern.

When you initialize the CKDS and master key or change the master key, ICSF calculates a verification pattern and places it into this field. ICSF calculates the verification pattern by using the current master key and the verification algorithm that is described in “Algorithm for Calculating a Verification Pattern” on page 327.

Master key authentication pattern
(Character length 8 bytes) The system master key authentication pattern.

When you initialize the CKDS and master key or change the master key, ICSF calculates an authentication pattern and places it into this field. ICSF calculates the authentication pattern by using the current master key and the authentication pattern algorithm that is described in “Algorithm for Calculating an Authentication Pattern” on page 327.

Whenever you start ICSF, ICSF uses the authentication pattern to verify that the current master key is the master key that enciphers the current CKDS. ICSF fails if the authentication pattern that is stored in the CKDS and the authentication pattern that ICSF calculates at startup do not match.

Installation Data (Character length 52 bytes) Using the KGUP installation exit, you can place information associated with the key entry into this field.

Authentication code
(Character length 4 bytes) The message authentication code computed on the previous fields of the record using a system key that is a MAC generation key. ICSF creates the code after ICSF creates the system keys at CKDS initialization. ICSF uses the code to verify the CKDS when the CKDS is read.

End of Programming Interface information

In the KGUP job stream, it is defined by the CSFCKDS data definition statement.

Control Statement Input Data Set

This data set contains the control statements that the particular KGUP job processes. For a description of the syntax of these control statements, see "Using KGUP Control Statements" on page 218.

This data set is a physical sequential data set with a fixed logical record length (LRECL) of 80 bytes.

Note: If a control statement adds or updates a key, later control statements in the control statement input data set for that KGUP job use the new or updated key.

In the KGUP job stream, the control statement input data set is defined by the CSFIN data definition statement.

Diagnostics Data Set

This data set contains a copy of each input control statement that is followed by one or more diagnostic messages that were generated for that control statement. It is a physical sequential data set with a fixed logical record length (LRECL) of 133 bytes. It should be fixed with ASA codes. Figure 210 shows an example of a diagnostics data set.

```
KEY GENERATION DIAGNOSTIC REPORT  DATE:1997/9/14 TIME:12:10:15  PAGE 1



 /* THIS IS A KEY USED TO EXPORT KEYS FROM A TO B */
 ADD TYPE(EXPORTER) TRANSKEY(TK1),
  LABEL(ATOB)
 > > > CSFG0321  STATEMENT SUCCESSFULLY PROCESSED.




 /* THIS IS A KEY USED TO IMPORT KEYS FROM B TO A */
 ADD TYPE(IMPORTER) TRANSKEY(TK1),
  LABEL(BTOA)
 > > > CSFG0321  STATEMENT SUCCESSFULLY PROCESSED.
```

Figure 210. Diagnostics Data Set Example

In the KGUP job stream, the data set is defined by the CSFDIAG data definition statement.

Key Output Data Set

This data set contains information about each key KGUP generates, except an importer key used to protect a key that is stored with a file. Each entry contains the key value and the complement key type of the key created. Another system can use this information to create a key that is the complement of the key your system created.

This data set is a physical sequential data set with a fixed logical record length (LRECL) of 208 bytes.

To establish key exchange with a system that does not use KGUP control statements, you can send that system information from this data set. The receiving system can then use this information to create the complement of the key you created. You can print or process this data set after KGUP ends.

KGUP only lists a record for the key if the TRANSKEY or CLEAR keyword was in the control statement. If the TRANSKEY keyword was specified in the output key data set, KGUP lists, for the key type, the complement of the control statement key type. KGUP lists, for the key value, the key encrypted under the transport key as specified by the TRANSKEY keyword.

The encrypted key is in the form of an external key token. An external key token contains the encrypted key value and control information about the key. For example, the token contains the control vector for the key type.

If the CLEAR keyword was specified, in the output key data set KGUP lists, for the key type, the complement of the control statement key type. KGUP lists, for the key value, the clear key value of the key. With this information another system could generate keys that are complements of the keys your system generated. This would permit your system and the other system to exchange keys.

When KGUP generates two complementary keys, each encrypted by a different transport key, KGUP lists a record for each key. The first record contains a key that is encrypted under the first transport key variant and the type that is specified on the control statement. The second record contains a key that is encrypted under the second transport key variant and a type that is the complement of the first key.

The records in the key output data set are in the following format:

Key label (Character length 64 bytes) The key label specified on the control statement.

Key type (Character length 8 bytes) The key type specified on the control statement or the complement of that key type if the TRANSKEY keyword was specified.

TRANSKEY label or `CLEAR`
(Character length 64 bytes) Either the key label of a transport key which encrypts the key entry or the character string `CLEAR` (left justified) if the key is unencrypted.

TRANSKEY type (Character length 8 bytes) The key type of the TRANSKEY, which is always exporter.

Key Token (Character length 64 bytes) A key token is composed of the key value and control information. The key value in this field is either unencrypted or encrypted under a transport key. For a description of format of a key token, see the *OS/390 ICSF System Programmer's Guide*.

In the KGUP job stream, the data set is defined by the CSFKEYS data definition statement.

Control Statement Output Data Set

KGUP produces an output control statement for every key that is generated as a result of an input control statement with the TRANSKEY keyword specified. The output control statement contains the complement key type of the key type

that is specified on the input control statement. The value that is output for the KEY keyword is encrypted under the transport key that is specified on the input control statement.

You can edit the output control statements and distribute them to the appropriate sites for input to KGUP at those locations.

The data set is a physical sequential data set with a fixed logical record length (LRECL) of 80 bytes.

One output control statement appears when you have KGUP generate a key value and create an operational and exportable key pair using a transport key.

Two output control statements appear when you have KGUP generate two exportable keys by using two different transport keys. These statements generate complementary keys types. You can send each statement to a different site to establish communication between the two sites.

In the KGUP job stream, the data set is defined by the CSFSTMNT data definition statement.

The specific name of these types of data sets must appear in the job stream that runs KGUP.

Submitting a Job Stream for KGUP

The key generator utility program (KGUP) is an APF-authorized program that runs as a batch job. It requires certain JCL statements to run. Submit the JCL to run KGUP after you create the KGUP control statements and data sets.

The JCL to run KGUP should be in the following format:

```
//KGUPPROC EXEC PGM=CSFKGUP,PARM=('SSM')
//CSFCKDS  DD   DSN=PROD.CKDS,DISP=OLD
//CSFIN    DD   DSN=PROD.KGUPIN.GLOBAL,DISP=OLD
//CSFDIAG  DD   DSN=PROD.DIAG.GLOBAL,DISP=OLD
//CSFKEYS  DD   DSN=PROD.KEYS.GLOBAL,DISP=OLD
//CSFSTMNT DD   DSN=PROD.STMT.GLOBAL,DISP=OLD
//
```

Figure 211. KGUP Job Stream

The EXEC statement specifies the load module name for KGUP. The PARM keyword on the EXEC statement passes information to KGUP. The keyword specifies either:

- NOSSM to indicate that special secure mode must be disabled
- SSM to indicate that special secure mode must be enabled

You must pass the SSM parameter if any KGUP control statements for the KGUP run contain the CLEAR keyword. NOSSM is the default.

If special secure mode is not enabled and you pass the SSM parameter to KGUP, the program ends immediately without processing any KGUP control statements. If you pass the NOSSM parameter and KGUP encounters a control statement with the CLEAR keyword, the job ends immediately.

In the JCL example, the PARM keyword specifies SSM to indicate that special secure mode should be enabled. You specify SSM if any control statement in the control statement input data set, PROD.KGUPIN.GLOBAL, contains the CLEAR keyword.

In the JCL, the data definition (DD) statements name the data sets necessary to input information to KGUP and output information from the program. See "Specifying KGUP Data Sets" on page 239 for a detailed description of these data sets.

Attention: If a KGUP job ends prematurely, results of the job are unpredictable. You should not read that cryptographic key data set into storage for use.

For a description of the KGUP return codes, see the explanation of message CSFG0002, which is in the *OS/390 ICSF Messages* manual.

Enabling Special Secure Mode

Before you pass the SSM parameter to KGUP in a JCL statement, you need to enable special secure mode processing. The steps you take to do this depend on your processor hardware.

- On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, specify SSM(YES) in the installation options data set

  If you use logical partition (LPAR) mode, you also need to enable special secure mode on the Change LPAR Crypto panel from the Hardware Master Console of the server support element. If you have the optional TKE workstation, you can use it to enable and disable special secure mode.

- On a bipolar processor, specify SSM(YES) in the installation options data set and also set a key switch on the key storage unit to the **Special Secure Mode** position.

  If you use logical partition (LPAR) mode, you also need to enable special secure mode on the PR/SM Logical Partition Security (LPSEC) frame. For more information about PR/SM considerations, refer to Appendix C, "PR/SM Considerations during Key Entry" on page 331.

Running KGUP Using the MVS/ESA Batch Local Shared Resource (LSR) Facility

The MVS/ESA batch LSR subsystem improves performance for random access file processing by reducing the number of inputs and outputs to VSAM data sets. Batch LSR allows a program to use local shared resources rather than non-shared resources. For information about the batch LSR subsystem, see the *MVS Batch Local Shared Resources* manual.

VSAM provides a deferred write option on VSAM ACB processing when a program uses shared resources. For more information about VSAM processing, see the *MVS/DFP Managing VSAM Data Sets* and the *MVS/ESA Data Administration: Macro Instruction Reference* manual.

By using the batch LSR subsystem and the VSAM deferred write option together, you may improve KGUP performance when adding many keys, for example 10,000 keys, to the CKDS. If your installation has batch LSR and VSAM deferred write,

you may improve performance when adding a large number of keys by using different JCL in the KGUP job stream.

Instead of using the following CSFCKDS DD statement:

```
//CSFCKDS DD DSN=cryptographic-key-data-set-name,DISP=OLD
```

Use the following DD statements:

```
//CSFALT  DD DSN=cryptographic-key-data-set-name,DISP=OLD
//CSFCKDS DD SUBSYS=(BLSR,'DDNAME=CSFALT',
//           'DEFERW=YES')
```

You should specify a large amount of storage for the REGION parameter (for example, REGION=32M) on the JOB or EXEC JCL statement. The rest of the JCL statements to run the KGUP job should be in the format that is shown in Figure 211 on page 244.

Reducing Control Area Splits and Control Interval Splits from a KGUP Run

KGUP processes keys on a disk copy of a CKDS which is a VSAM data set. KGUP uses key-direct update processing to process the keys. To access keys, VSAM uses the key's label as the VSAM key. This means that keys are added to the data set in collating sequence. That is, if two keys named A and B are in the data set, A appears earlier in the data set than B. As a result, adding keys to the data set can cause multiple VSAM control interval splits and control area splits. For example, a split might occur if the data set contains keys A, B, E and you add C (C must be placed between B and E). These splits can leave considerable free space in the data set.

The amount of control area splits and control interval splits in the CKDS affects performance. You may want to periodically use the TSO LISTCAT command to list information about the number of control area splits and control interval splits in a CKDS.

You can help reduce the frequency of control interval and control area splits by ensuring that key generator utility control statements are always in the correct collating sequence, A-Z, 0-9, if possible. When adding keys to a new CKDS, add the key entries in sequential order. Also, after adding new entries to the CKDS, you can reorganize the data set to reduce control area splits and control interval splits. To do this, copy the disk copy of the CKDS into another disk copy using the AMS REPRO command or AMS EXPORT/IMPORT commands. You may want to reorganize the data set after every KGUP run.

Note: If it is practical, you may want to perform the following procedure to reduce control area splits. If you are inserting a large number of keys in the middle of a CKDS, you may want to remove and save all the keys after the place in the data set where you are inserting the keys. In this way, you are adding the keys to the end rather than the middle of the data set. When you finish adding the keys, place the keys that you removed back in the data set.

For a detailed explanation of keyed-direct update processing and a description of what happens when control area and control interval splits occur, refer to the *MVS/DFP Managing VSAM Data Sets* manual.

Refreshing the In-Storage CKDS

ICSF functions access an in-storage copy of the CKDS when the functions reference keys by label. However when you use KGUP, the program makes changes to a disk copy of the CKDS. This situation allows you to maintain the keys in the data set without disturbing current cryptographic operations.

After you update the disk copy, you can use the Refresh option on the Key Administration panel to replace the in-storage copy with the disk copy. For a description of this panel path, see “Refreshing the Current CKDS Using the ICSF Panels” on page 270. Besides using the panels to refresh the in-storage CKDS, you can invoke a utility program to perform the task. Refer to “Refreshing the In-Storage CKDS Using a Utility Program” on page 318 for details.

Using KGUP Panels

The key generator utility program (KGUP) panels help you run KGUP by providing panels to do the following tasks:

- Create KGUP control statements.
- Specify the data sets for KGUP processing.
- Invoke KGUP by submitting job control language (JCL) statements.
- Replace the in-storage copy of the cryptographic key data set (CKDS) with the disk copy that KGUP processing changed.

Using the panels, you can perform the tasks to use KGUP to generate or receive keys for PIN and key distribution and to maintain the CKDS.

To access the KGUP panels, select option 2, KGUP, on the Primary Menu panel as shown in Figure 212.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 2

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
  6  CKDS          -  CKDS Refresh and Initialization
  7  USERCNTL      -  User control functions
  8  PPINIT        -  Pass Phrase Master Key/CKDS Initialization
  9  PCICC MGMT    -  Management of PCI Cryptographic Coprocessors
```

Figure 212. Selecting the KGUP Option on the Primary Menu Panel

The Key Administration panel appears. See Figure 213 on page 248.

```
CSFSAM00 ----------------- OS/390 ICSF - Key Administration ---------------
OPTION ===>


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Dataset        - Specify datasets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key dataset


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 213. Key Administration Panel

This panel allows you to access panels to perform the tasks to run KGUP. The following sections describe the KGUP tasks.

Creating KGUP Control Statements Using the ICSF Panels

You create the control statements to specify the functions you want KGUP to perform. When you create the control statements, ICSF stores the statements in the control statement input data set.

After you create the control statements, do one of the following procedures:

- Process the control statements by running KGUP.
- Do not process the control statements and just save the statements in the data set. Then at another time you can access the data set to add more control statements and submit the data set for KGUP processing.

To create the KGUP control statements:

1. Select option 1, Create, on the Key Administration panel, as shown in Figure 214, and press ENTER.

```
CSFSAM00 ----------------- OS/390 ICSF - Key Administration ---------------
OPTION ===> 1


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Dataset        - Specify datasets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key dataset
```

Figure 214. Selecting the Create Option on the Key Administration Panel

   The KGUP Control Statement Data Set Specification panel appears. See Figure 215 on page 249.

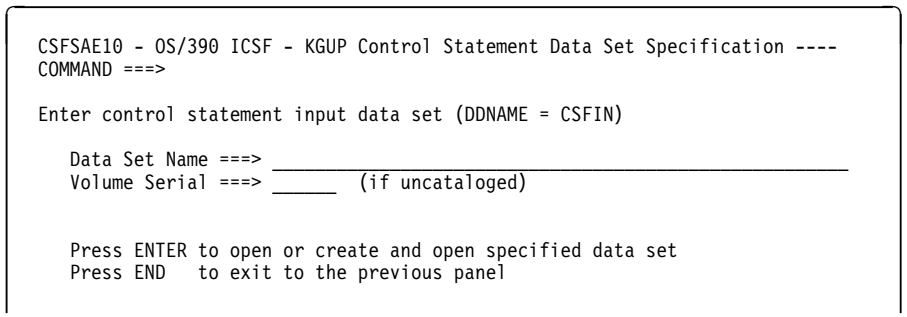

Figure 215. KGUP Control Statement Data Set Specification Panel

2. Enter the name of the data set that you want to contain the control statements for KGUP processing.
   a. For partitioned data sets, specify a member name as part of the data set name.
   b. If the data set is not cataloged, you must also specify the volume serial for the data set in the Volume Serial field. This volume serial allows ICSF to access the correct volume when ICSF opens the data set.

   Note: If you specify NOPREFIX in your TSO profile, so data sets are not automatically prefixed with your userid, you must specify the fully qualified data set name within apostrophes. If you specify PREFIX without a valid prefix, your TSO userid becomes the prefix.

   Depending on your requirements, there are several options to choose from when entering the data set name. Refer to Figure 216 for a list of these options and the steps to follow for each.

Figure 216. Data Set Name Options

Option	Steps
To have KGUP append the control statements to an existing data set when you know the data set name and the member name	1. Specify the data set name and member name of the existing data set and press ENTER. The KGUP Control Statement Menu appears. See Figure 220 on page 252. The new control statements will be appended after any existing control statements in the data set.
To have KGUP append the control statements to an existing data set when you know the data set name but not the member name	1. Specify the data set name of the existing data set and press ENTER. If the partitioned data set is not empty, the Member Selection List appears. See Figure 218 on page 251. 2. On the Member Selection List panel: • To select a member that already exists, place an s to the left of the member name in the list and press ENTER. For example, in Figure 218 on page 251 SHIFT2 is selected so the data set LARSON.CSFIN.TESTDS1P(SHIFT2) becomes the input control statement data set. • To locate a member on the selection list, type an l (the lowercase letter L) and the member name on the command line and press ENTER. The list moves so the member appears on the top line of the list and the cursor appears to the left of the member. • To create a new member, type s and the new member name on the command line and press ENTER. The KGUP Control Statement Menu appears. See Figure 220 on page 252. The new control statements will be appended after any existing control statements in the data set.
To have KGUP create a new data set	1. Specify a name for the new data set and press ENTER. The Allocation panel appears. See Figure 219 on page 252. 2. Enter the necessary information to allocate a new data set and press ENTER. The KGUP Control Statement Menu appears. See Figure 220 on page 252. The new control statements will be stored in the new data set.

Figure 217 on page 251 shows an example of the KGUP Control Statement Data Set Specification panel with the partitioned data set CSFIN.TESTDS1P and a member name of TEST1.

```
CSFSAE10 - OS/390 ICSF - KGUP Control Statement Data Set Specification ----
COMMAND ===>

Enter control statement input data set (DDNAME = CSFIN)

   Data Set Name ===> CSFIN.TESTDS1P(test1)_____________________________
   Volume Serial ===> ______  (if uncataloged)


   Press ENTER to open or create and open specified data set
   Press END   to exit to the previous panel
```

Figure 217. Entering a Data Set Name on the KGUP Control Statement Data Set Specification Panel

If the member TEST1 did not previously exist, ICSF creates the member. If the member already exists, ICSF appends the control statements to the end of the data set. <Prefix>.CSFIN.TESTDS1P(test1) becomes the control statement input data set.

If you specify CSFIN.TESTDS1P without the member name, the Member Selection List panel appears. See Figure 218.

```
CSFSAE12 --------- OS/390 ICSF - Member Selection List --------- ROW 1 To 6 OF 6
COMMAND ===>                                                  SCROLL ===> PAGE

Data Set:  LARSON.CSFIN.TESTDS1P
Select one member name only
    NAME          CREATED     CHANGED       SIZE   INIT    MOD    USERID
   PINEX1        95/08/04 96/08/05 10:44      26     24      1   LARSON
   PINEX2        95/08/04 96/07/04 11:23      14     14      0   LARSON
   KEYEX1        95/08/04 96/08/05 12:44       6      6      1   LARSON
s  SHIFT2        95/08/04 96/08/12 10:55     195    137      2   LARSON
   SHIFT3        95/08/04 96/08/05 12:44      48      4      1   LARSON
   TEST1         95/08/04 96/08/05 11:44       4      4      1   LARSON
****************************** BOTTOM OF DATA ********************************
```

Figure 218. Member Selection List Panel

If you specify a new data set name, the Allocation panel appears. See Figure 219 on page 252.

```
CSFSAE11 --------------- OS/390 ICSF - Allocation ------------------------
COMMAND ===> _

DATA SET NAME: LARSON.CSFIN.TESTDS1P
  Data set cannot be found.  Specify allocation parameters below.

   VOLUME SERIAL      ===> ______       (Blank for authorized default volume) *
   GENERIC UNIT       ===> ________     (Generic group name or unit address) *
   SPACE UNITS        ===> BLOCK_____   (BLKS, TRKS, or CYLS)
   PRIMARY QUANTITY   ===> 10____       (In above units)
   SECONDARY QUANTITY ===> 5_____       (In above units)
   DIRECTORY BLOCKS   ===> 10____       (Zero for sequential data set)
   RECORD FORMAT      ===> FB
   RECORD LENGTH      ===> 80
   BLOCK SIZE         ===> 6400__       (In multiples of record length)
   EXPIRATION DATE    ===> _____        (Format is YYDDD)

   ( * Only one of these fields may be specified)



   Press ENTER to allocate specified data set and continue
   Press END   to exit to the previous panel without allocating
```

Figure 219. Entering Data Set Information on the Allocation Panel

Once the data set has been selected or created, the data set becomes the control statement input data set on the KGUP Control Statement Menu, as shown in Figure 220. The name of the control statement input data set you specified appears at the top of the panel.

From this panel, you can press END to go back to the KGUP Control Statement Data Set Specification panel. On the later panel you can either specify another data set to store control statements, or press END again to return to the Key Administration panel.

```
CSFCSM00 ----------- OS/390 ICSF - KGUP Control Statement Menu ------------
OPTION ===> _

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 220. KGUP Control Statement Menu Panel

3. Choose the type of control statement you want to create and press ENTER.

- To create an ADD, UPDATE, or DELETE control statement, select option 1. For information, see “Creating ADD, UPDATE, or DELETE Control Statements” on page 253.
- To create a RENAME control statement, select option 2. For information, see “Creating a RENAME Control Statement” on page 259.
- To create a SET control statement, select option 3. For information, see “Creating a SET Control Statement” on page 261.
- To edit the input control statement data set, select option 4. For information, see “Editing Control Statements” on page 262.

After you choose the Maintain, Rename, or Set option, you access the panels to create the control statement you want. When you create a control statement, the statement is placed in the specified control statement input data set. To edit the control statements that are stored in this data set, choose the Edit option.

Creating ADD, UPDATE, or DELETE Control Statements

When you select Maintain (option 1) on the KGUP Control Statement Menu panel, the Create ADD, UPDATE, or DELETE Key Statement panel appears. See Figure 221.

```
CSFCSE10 --- OS/390 ICSF - Create ADD, UPDATE, or DELETE Key Statement -----------
COMMAND ===>
Specify control statement information below

   Function ===> ______      ADD, UPDATE, or DELETE
   Key Type ===> ________     Outtype ===> ________    (Optional)
   Label ===> ____________________________________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________________
   End   ===> ____________________________________________________________________

    Transport Key Label(s)
         ===> ____________________________________________________________________
         ===> ____________________________________________________________________
 or Clear Key              ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES    CDMF ===> NO   NO or YES
   Length of Key  ===> 16   8, 16 or 24  DES  ===> YES  NO or YES
   Key Values     ===> ________________ ,________________ ,________________
   Comment Line   ===> ____________________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 221. Create ADD, UPDATE, or DELETE Key Statement Panel

1. On the panel, fill out the fields to create the ADD, UPDATE, or DELETE control statement that you want KGUP to process. Each field on the panel corresponds to a control statement keyword. The panel helps you to create a complete, syntactically correct ADD, UPDATE, or DELETE control statement.

   The panel creates control statements according to the syntax described in “Syntax of the ADD and UPDATE Control Statements” on page 219. See that section for more information about the control statement keywords.

2. In the Function field, select the function you want KGUP to perform.

Function	Result
ADD	Enter new key entries in the CKDS. Generate and receive key values for key distribution.
UPDATE	Change existing entries in the CKDS. Generate and receive key values for key distribution.
DELETE	Remove entries from the CKDS.

You can just type the first letter of the function in the first position in a field on the panel. For example, in Figure 222, `a` was entered in the Function field to specify the ADD function. ICSF recognizes the abbreviation.

For a description of the keywords you must specify for each function, see "Using the ADD and UPDATE Control Statements for Key Management and Distribution Functions" on page 225.

```
CSFCSE10 --- OS/390 ICSF - Create ADD, UPDATE, or DELETE Key Statement ----------
COMMAND ===>
Specify control statement information below

   Function ===> a_____     ADD, UPDATE, or DELETE
   Key Type ===> ________    Outtype ===> ________    (Optional)
   Label ===> ____________________________________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________________
   End   ===> ____________________________________________________________________

    Transport Key Label(s)
         ===> ____________________________________________________________________
         ===> ____________________________________________________________________
 or Clear Key               ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES    CDMF ===> NO_  NO or YES
   Length of Key  ===> 16   8, 16 or 24  DES  ===> YES  NO or YES
   Key Values     ===> ________________ ,________________ ,________________
   Comment Line   ===> ____________________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 222. Selecting the ADD Function on the Create ADD, UPDATE, or DELETE Key Statement Panel

3. In the Key Type field, enter the type of key you want KGUP to process with the control statement. This field represents the TYPE keyword on the control statement.

   If you leave the Key Type Field blank and press ENTER, the Key Type Selection panel appears. See Figure 223 on page 255.

```
CSFCSE12-------- OS/390 ICSF - Key Type Selection Panel ----  ROW 1 TO 13 OF 11
COMMAND ===>                                                 SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   DATA       Data-encrypting key
   DATAM      Double-length MAC generation key
   DATAMV     Double-length MAC verification key
   DATAXLAT   Data-translation key
s  EXPORTER   Export key-encrypting key
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
   MAC        Message authentication key
   MACVER     Message verification key
   NULL       Dummy CKDS records
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
*********************************BOTTOM OF DATA*********************************
```

Figure 223. Selecting a Key on the Key Type Selection Panel

a. Type s to the left of the key type you want to specify from the displayed list of key types.

   In Figure 223, the exporter key is selected.

b. After you have specified a key type, press ENTER to return to the Create ADD, UPDATE, or DELETE Key Statement panel, as shown in Figure 224.

```
CSFCSE10 --- OS/390 ICSF - Create ADD, UPDATE, or DELETE Key Statement -----------
COMMAND ===>
Specify control statement information below

   Function ===> ADD___      ADD, UPDATE, or DELETE
   Key Type ===> EXPORTER    Outtype ===> ________    (Optional)
   Label ===> ATMBRANCH5M0001_____________________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> _____________________________________________________________________
   End   ===> _____________________________________________________________________

    Transport Key Label(s)
         ===> tkatmbranch5m0001_____________________________________________________
         ===> _____________________________________________________________________
 or Clear Key              ===> NO_         NO or YES

   Control Vector ===> YES  NO or YES    CDMF ===> NO_  NO or YES
   Length of Key  ===> 16   8, 16 or 24  DES  ===> YES  NO or YES
   Key Values     ===> ________________ ,________________ ,________________
   Comment Line   ===> export test key_____________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 224. Completing the Create ADD, UPDATE, or DELETE Key Statement Panel

If you abbreviated the control statement function, the function now appears in its full form. The type of key you selected on the Key Type Selection panel appears in the Key Type field.

4. Specify either a label or range to identify the label of the key entry in the CKDS that you want KGUP to process.

The Label field represents the LABEL keyword on the control statement. The Range field represents the RANGE keyword on the control statement. In the Range fields, specify the first and last label in a range of labels you want KGUP to process.

Figure 225. Selecting Range and Label Options

Option	Steps
To have KGUP process only one key label	1. Specify the key label in the Label field. 2. Type NO in the Group Labels field.
To have KGUP process more than one key label	1. Specify the first label in the Label field. 2. Type YES in the Group Labels field.

5. Specify either a transport key label or YES in the Clear Key field.

   The Transport Key Label field represents the TRANSKEY keyword on the control statement. The Clear Key field represents the CLEAR keyword. These keywords are mutually exclusive.

   When KGUP generates a key, the program places the key value in a data set so you can send the value to another system. The other system uses the value to create the complement of the key. You send the key value as either a clear key value or a key value encrypted under a transport key.

   When KGUP imports a key value, the program may import a clear or encrypted key value. KGUP decrypts the encrypted key value from under the transport key that you specify in the Transport Key Label field.

Figure 226. Selecting the Transport Key Label and Clear Key Label Options

Option	Steps
To have KGUP generate a key other than an importer key and encrypt the key value	1. Specify the label of the transport key you want KGUP to use to encrypt the key in the Transport Key Label field. 2. Type NO in the Clear Key field.
To have KGUP generate a key other than an importer key and leave the key value in the clear	1. Leave the Transport Key Label field blank 2. Type YES in the Clear Key field.
To have KGUP import an encrypted key	1. Specify the label of the transport key you want KGUP to use to dencrypt the key in the Transport Key Label field. 2. Type NO in the Clear Key field.
To have KGUP import a clear key	1. Leave the Transport Key Label field blank 2. Type YES in the Clear Key field.

6. Specify either YES or NO in the Control Vector field.

   Usually the cryptographic facility exclusive ORs a transport key with a control vector before the transport key encrypts a key. However, if your system is exchanging keys with a system like CUSP or PCF that does not use control vectors, you need to specify that no control vector be used. If you want KGUP to generate a transport key that uses a control vector, type YES in the Control Vectors field. Otherwise type NO. If you type NO in this field, the control statement contains the NOCV keyword.

7. If you want KGUP to work with a single-length key in its processing, type YES in the Length of Key field. Otherwise, type NO. If you type YES in the field, the control statement contains the LENGTH keyword.
8. If you want KGUP to generate a key that is marked for use with the DES algorithm, specify YES for DES and NO for CDMF. If you want KGUP to generate a key that is marked for use with the CDMF algorithm, specify NO for DES and YES for CDMF.

   The CDMF and DES keywords are valid only with the ADD and UPDATE requests and only when the key type is IMPORTER or EXPORTER.
9. If you are entering a key value, enter the key value in the Key Values field.

   You enter the value as three values if the key is a triple-length key, two values if the key is a double-length key, or as one value if the key is a single-length key. The Key Values field represents the KEY keyword on the control statement.
10. In the Comment Line field, you can enter up to 45 characters of information about the control statement. The information appears as a comment that precedes the control statement in the input control statement data set.
11. After you enter all the information on this panel, press ENTER.

    If you entered YES in the Group Labels field, the Group Label panel appears. See Figure 227.

```
CSFCSE11 ----------------- OS/390 ICSF - Group Label Panel ------------------
COMMAND ===>

First label:

  ATMBRANCH5M0001_____________________________________________

Enter at least one other label:

  ATMBRANCH5M0020_____________________________________________
  ATMBRANCH5M0030_____________________________________________
  ATMBRANCH5M0050_____________________________________________
  _____________________________________________________________
  _____________________________________________________________
  _____________________________________________________________
  _____________________________________________________________
  _____________________________________________________________
  _____________________________________________________________



Press ENTER to add more labels or create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 227. Specifying Multiple Key Labels on the Group Label Panel

   a. Enter any additional key labels you want KGUP to process with the control statement.

      The first label you entered in the Label field of the Create ADD, UPDATE, or DELETE Key Statement panel appears at the top of this panel. If you enter duplicate labels, an error message appears on the right side of the panel and the cursor appears on the duplicate label. If the syntax of the label is incorrect, an error message appears and the cursor appears on the incorrect label.

b. If you have more labels than will fit on this panel, press the ENTER key after you have filled each line on the panel. An additional Group Label Panel appears. Type the remaining labels and press ENTER.

   ICSF writes the control statement to the input control statement data set. You return to the Create ADD, UPDATE, or DELETE Key Statement panel.

If you entered NO in the Group Labels field, you do not access the Group Label panel. You remain on the Create ADD, UPDATE, or DELETE Key Statement panel.

12. Press ENTER to have ICSF write the control statement in the input control statement data set.

    If a specification in any field is incorrect, when ICSF processes the control statement it displays an appropriate message on the top line of the panel. The cursor then appears in the field with the error. To display the long version of the error message at the bottom of the panel, press the HELP key (F1). If you correct the error and press ENTER again, ICSF writes the control statement to the control statement input data set.

    If a control statement was created, the message SUCCESSFUL UPDATE appears on the right side of the top line of the panel, as shown in Figure 228.

```
CSFCSE10 - OS/390 ICSF - Create ADD, UPDATE, DELETE Statement SUCCESSFUL UPDATE
COMMAND ===>
Specify control statement information below

   Function ===> ADD____     ADD, UPDATE, or DELETE
   Key Type ===> EXPORTER    Outtype ===> ________    (Optional)
   Label ===> ATMBRANCH5M0001_____________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________
   End   ===> ____________________________________________________________

    Transport Key Label(s)
         ===> TKATMBRANCH5M0001_____________________________________________
         ===> ____________________________________________________________
 or Clear Key              ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES   CDMF ===> NO_  NO or YES
   Length of Key  ===> 16   8,16 or 24  DES  ===> YES or NO
   Key Values     ===> ________________ ,________________ ,________________
   Comment Line   ===> EXPORT TEST KEY_____________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 228. Create ADD, UPDATE, or DELETE Key Statement Panel Showing Successful Update

13. If you want to create another ADD, UPDATE, or DELETE control statement, enter new information in the fields to create the control statement.
14. After you specify the information, press ENTER to place the control statement in the control statement input data set.
15. If you do not want to create another ADD, UPDATE, or DELETE control statement, press END to return to the KGUP Control Statement Menu panel.

Creating a RENAME Control Statement

The Create RENAME Control Statement panel appears. The RENAME control statement changes the label of a key entry in a CKDS. To create a RENAME control statement:

1. Choose option 2 on the KGUP Control Statement Menu, as shown in Figure 229.

```
CSFCSM00 ----------- OS/390 ICSF - KGUP Control Statement Menu ------------
OPTION ===> 2

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set
```

Figure 229. Selecting the Rename Option on the KGUP Control Statement Menu Panel

See Figure 230.

```
CSFCSE20 --------- OS/390 ICSF - Create RENAME Control Statement ----------
COMMAND ===>

Enter the following information:

   Existing Key Label
     _____________________________________________________________

   New Key Label
     _____________________________________________________________

   Key Type           ===> ________         Selection panel displayed if blank

   Comment Line       ===> ________________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel
```

Figure 230. Create RENAME Control Statement Panel

If you leave this field blank, the On this panel, you enter information in the fields to create a RENAME control statement. This panel creates a RENAME control statement according to the syntax described in “Syntax of the RENAME Control Statement” on page 232. See that section for more information about the RENAME control statement keywords.

2. In the Existing Key Label field, specify the current label on the CKDS that you want KGUP to change.
3. In the New Key Label field, specify the new label that you want to replace the existing label.
4. In the Key Type field, specify the key type of the key entry whose label you want changed. Key Type Selection panel appears. See Figure 231 on page 260.

```
CSFCSE12--------- OS/390 ICSF - Key Type Selection Panel ----- ROW 1 To 13 OF 11
COMMAND ===>                                                  SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   DATA       Data-encrypting key
   DATAM      Double-length MAC generation key
   DATAMV     Double-length MAC verification key
   DATAXLAT   Data-translation key
s  EXPORTER   Export key-encrypting key
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
   MAC        Message authentication key
   MACVER     Message verification key
   NULL       Dummy CKDS records
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
*******************************BOTTOM OF DATA*********************************
```

Figure 231. Selecting a Key Type on the Key Type Selection Panel

a. Type s to the left of the key type you want to specify.

   In Figure 231, the exporter key is selected.

b. Press ENTER to return to the Create RENAME Control Statement panel.

   The RENAME control statement The key type you choose on the Key Type Selection panel appears in the key type field.

An example of a Create RENAME Control Statement panel which creates a control statement to change the key label JWL@SSIDEC95 to JWL@SSIJUNE96 for an exporter key is shown in Figure 232.

```
CSFCSE20 --------- OS/390 ICSF - Create RENAME Control Statement ----------
COMMAND ===>

Enter the following information:

   Existing Key Label
     JWL@SSIDEC95_____________________________________________________

   New Key Label
     JWL@SSIJUNE96____________________________________________________

   Key Type           ===> ex______         Selection panel displayed if blank

   Comment Line       ===> export test key renamed_____________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel
```

Figure 232. Completing the Create RENAME Control Statement Panel

5. In the Comment Line field, you can enter up to 45 characters of information about the control statement.

   The information appears as a comment that precedes the control statement in the input control statement data set.

6. After you enter all the information on the Create RENAME Control Statement panel, press ENTER.

   ICSF writes the control statement in the input control statement data set.

If a specification in any field is incorrect, when ICSF processes the control statement it displays an appropriate message on the top line of the panel. The cursor then appears in the field with the error. To display the long version of the error message at the bottom of the panel, press the HELP key (F1). You can correct the error and press ENTER again so ICSF can write the control statement to the control statement input data set.

The Create SET Control Statement panel appears. If a control statement was created, the message SUCCESSFUL UPDATE appears on the right side of the top line of the panel.

7. To create another RENAME control statement, enter new information in the fields to create the control statement.
8. After you specify the information, press ENTER to place the control statement in the control statement input data set.
9. When you have finished creating RENAME control statements, press END to return to the KGUP Control Statement Menu panel.

Creating a SET Control Statement

The SET control statement specifies data for KGUP to send to a KGUP exit routine. To create a SET control statement:

1. Choose option 3 on the KGUP Control Statement Menu, as shown in Figure 233.

```
CSFCSM00 ----------- OS/390 ICSF - KGUP Control Statement Menu ------------
OPTION ===> 3

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set
```

Figure 233. Selecting the Set Option on the KGUP Control Statement Menu Panel

See Figure 234.

```
CSFCSE30 ----------- OS/390 ICSF - Create SET Control Statement -----------
COMMAND ===>

Specify installation data for exit processing

  Installation Data ===> ________________________________________________

  Comment Line      ===> ____________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 234. Create SET Control Statement Panel

From this panel you can creates a SET control statement. For information about the SET control statement keywords, refer to “Syntax of the SET Control Statement” on page 233.

2. In the Installation Data field, enter the data to pass to a KGUP installation exit.
3. In the Comment Line field, you can enter up to 45 characters of information about the control statement.

   The information appears as a comment that precedes the control statement in the input control statement data set.

   An example of a Create SET Control Statement panel which passes date information to the installation exit is shown in Figure 235.

```
CSFCSE30 ----------- OS/390 ICSF - Create SET Control Statement -----------
COMMAND ===>

Specify installation data for exit processing

  Installation Data ===> BRANCH051992110119930131_____________________________

  Comment Line      ===> Branch 5 POS terminal date information_________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 235. Completing the Create SET Control Statement Panel

4. After you enter all the information on this panel, press ENTER.

   ICSF writes the control statement in the input control statement data set.

   When the control statement is created, the message `SUCCESSFUL UPDATE` appears on the right side of the top line of the panel.
5. Press END to return to the KGUP Control Statement Menu panel.

Editing Control Statements

You can edit the control statement input data set that you specified for this KGUP job. The control statement input data set contains the control statements you created after you specified the control statement input data set.

To edit the control statements you created:

1. Choose option 4 on the KGUP Control Statement Menu panel, as shown in Figure 236 on page 263.

```
CSFCSM00 ----------- OS/390 ICSF - KGUP Control Statement Menu ------------
OPTION ===> 4

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 236. Selecting the Edit Option on the KGUP Control Statement Menu Panel

The ISPF editor displays the control statement input data set. An example of a data set called LARSON.CSFIN.TESTDS1P(TEST2) with a SET, ADD, and RENAME control statement is shown in Figure 237.

```
ISREDDE - LARSON.CSFIN.TESTDS1P(TEST2) - 00.00 --------------- COLUMNS 001 072
COMMAND ===> _                                                SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
000001 /* TEST INSTALLATION DATA                        */
000002 SET INSTDATA('This is test installation data')
000003 /* EXPORT TEST KEY                               */
000004 ADD TYPE(EXPORTER),
000005        TRANSKEY(SENDTOBRANCH5JUNE99)
000006        LABEL(ATMBRANCH5M0001)
000007 /* EXPORT TEST KEY RENAMED                       */
000008 RENAME LABEL(JWL@SSIDEC97,JWL@SSIJUNE99) TYPE(EXPORTER)
****** ************************** BOTTOM OF DATA ***************************
```

Figure 237. Edit Control Statement Initial Display Panel

2. You can change any information on the control statements in the data set. You can also add lines to the data set that contains comments or control statements.
3. To specify many similar control statements, copy lines in this file and edit them to create additional control statements.

   Note: The panel does not check whether the control statements that you change are syntactically correct.

   Figure 238 on page 264 shows the insertion of a comment line in the file.

```
ISREDDE - LARSON.CSFIN.TESTDS1P(TEST2) - 00.00 --------------- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
'' /* This comment was inserted using the editor */_
000001 /* TEST INSTALLATION DATA                        */
000002 SET INSTDATA('This is test installation data')
000003 /* EXPORT TEST KEY                               */
000004 ADD TYPE(EXPORTER),
000005        TRANSKEY(SENDTOBRANCH5JUNE99)
000006        LABEL(ATMBRANCH5M0001)
000007 /* EXPORT TEST KEY RENAMED                       */
000008 RENAME LABEL(JWL@SSIDEC97,JWL@SSIJUNE99) TYPE(EXPORTER)
****** ************************** BOTTOM OF DATA ***************************
```

Figure 238. Edit Control Statement Data Set with Insert

4. After you make any changes, press END to save the changes and return to the KGUP Control Statement Menu panel.

Specifying Data Sets Using the ICSF Panels

Before you run a KGUP job, you must specify the KGUP data sets for the program to use in its processing.

1. To access the panels to specify KGUP data sets, select option 2 on the Key Administration panel, as shown in Figure 239, and press ENTER.

```
CSFSAM00 ----------------- OS/390 ICSF - Key Administration ---------------
OPTION ===> 2


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 239. Selecting the Specify Data Set Option on the Key Administration Panel

The Specify KGUP Data Sets panel appears. See Figure 240 on page 265.

```
CSFSAE20 ---------------- OS/390 ICSF - Specify KGUP Data Sets ------------
COMMAND ===> _

Enter data set names for all cryptographic files.
 Cryptographic Key         (DDNAME = CSFCKDS)
   Data Set Name ===> _____________________________________________

 Control Statement Input   (DDNAME = CSFIN)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Diagnostics               (DDNAME = CSFDIAG)  (use * for printer)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Key Output                (DDNAME = CSFKEYS)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Control Statement Output  (DDNAME = CSFSTMNT)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

Press ENTER to set the data set names. Press END to exit to the previous panel.
```

Figure 240. Specify KGUP Data Sets Panel

This panel contains all the data sets that KGUP uses for input or output during processing. In the Data Set Name field under each type of data set, you specify the name of the data set for KGUP to use.

2. In the Cryptographic Key Data Set Name field, specify the name of the CKDS which contains the key entries that KGUP processes.

   You must initialize the CKDS by using the method that is described in “Initializing the CKDS at First-Time Startup” on page 176. The data set can be any disk copy of a CKDS that is enciphered under the current master key.

3. In the Control Statement Input Data Set Name field, specify the name of the data set that contains the control statements you want KGUP to process for this job.

4. In the Volume Serial field, enter the volume serial for the data set if it is not cataloged.

   If you specified a control statement input data set on the KGUP Control Statement Data Set Specification panel, the data set name appears in the Control Statement Input Data Set Name field on this panel. If you change the data set name on this panel, it automatically changes on the KGUP Control Statement Data Set Specification panel. Refer to Figure 215 on page 249 for an example of the KGUP Control Statement Data Set Specification panel.

5. In the Diagnostics Data Set Name field, specify the name of the data set where KGUP places the image of the control statements and any diagnostic KGUP generates.

   You do not have to allocate this data set before you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.

6. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.

If you enter an * in the Diagnostics Data Set Name field, the information is printed directly to a printer instead of a data set.

7. In the Key Output Data Set Name field, specify the name of the data set that contains key values that are generated to use to create complementary key values.

   You do not have to allocate this data set before you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.

8. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.

9. In the Control Statement Output Data Set Name field, specify the name of the data set that contains control statements generated to use to create complementary key values.

   You do not have to allocate this data set before you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.

10. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.

    For a more complete description of each of the data sets, see “Specifying KGUP Data Sets” on page 239.

    The data sets that you name appear on this panel the next time you access it.

    An example of a Specify KGUP Data Sets panel with the names of data sets specified for KGUP processing is shown in Figure 241.

```
CSFSAE20 ---------------- OS/390 ICSF - Specify KGUP Data Sets ------------
COMMAND ===> _

Enter data set names for all cryptographic files.
 Cryptographic Key         (DDNAME = CSFCKDS)
   Data Set Name ===> TEST.CSFCKDS_____________________________________

 Control Statement Input   (DDNAME = CSFIN)
   Data Set Name ===> CSFIN.TESTDS1P(TEST)_____________________________
   Volume Serial ===> ______  (if uncataloged)

 Diagnostics               (DDNAME = CSFDIAG)  (use * for printer)
   Data Set Name ===> *________________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Key Output                (DDNAME = CSFKEYS)
   Data Set Name ===> TEST.CSFKEYS_____________________________________
   Volume Serial ===> ______  (if uncataloged)

 Control Statement Output  (DDNAME = CSFSTMNT)
   Data Set Name ===> TEST.CSFSTMNT____________________________________
   Volume Serial ===> ______  (if uncataloged)

Press ENTER to set the data set names. Press END to exit to the previous panel.
```

Figure 241. Completing the Specify KGUP Data Sets Panel

11. Press ENTER to set the data set names.
12. Press END to return to the ICSF Key Administration panel.

Creating the Job Stream Using the ICSF Panels

The Set KGUP JCL Job Card panel appears. After you create the control statements and specify the data sets for KGUP processing, you submit the job to run KGUP. You submit a KGUP job stream to process control statements which modify a CKDS and output information to other data sets. The names of the data sets that KGUP uses are specified in the job stream.

1. To access the panels to create the KGUP job stream, select option 3 on the Key Administration panel, as shown in Figure 242, and press ENTER.

```
CSFSAM00 ----------------- OS/390 ICSF - Key Administration ---------------
OPTION ===> 3


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 242. Invoking KGUP by Selecting the Submit Option on the Key Administration Panel

See Figure 243. The first time you access this panel, the panel displays a JOB statement similar to the one that is shown in this example. ICSF displays your userid as the job name. From this panel you can create a job to run KGUP.

```
CSFSAE30 --------------- OS/390 ICSF - Set KGUP JCL Job Card --------------
COMMAND ===> _

   S  - Submit the KGUP job stream for execution
   E  - Edit the KGUP job stream and issue the TSO SUBMIT command

        Note:  If you choose E, and want to submit the job stream with
        your changes, issue the TSO SUBMIT command before you leave the
        edit session; your updates to the job stream will NOT be saved.

   Enter or verify job statement information:

   ===> //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C_____________________________
   ===> //*______________________________________________________________________
   ===> //*______________________________________________________________________
   ===> //*______________________________________________________________________

   Enter dsname of library containing Installation Exit Module:

   ===> ____________________________________________

   Special Secure Mode       ===> NO_  NO or YES

   Press END to exit to previous panel
```

Figure 243. Set KGUP JCL Job Card Panel

2. Change the job statement according to the specifications of your installation.

The line of the job control language that appears on this panel contains the job card that is needed to submit the job on the Job Entry Subsystem (JES). This panel displays some commonly used parameters that are installation dependent. A job name and the word JOB are the only required parameters on a job statement. All the other parameters are only required depending on your installation. You can delete or specify these parameters and add more parameters depending on the requirements of your installation. When you change the information that is displayed, ICSF saves these changes so they appear every time you display the panel.

a. In the ACCOUNT parameter, enter accounting information as specified by your installation.

b. In single quotes, enter the name that appears on the output of the job.

c. In the MSGCLASS parameter, set the output class for the job log.

   After you specify the JOB statement information, the panel displays three comment lines where you can include any information about the job.

d. If all the parameters do not fit on the first line, delete the * on the second line and continue the JOB statement parameters.

3. If your installation calls an installation exit during KGUP processing and the library containing the exit load module is not in the link list, specify the library in the "Enter dsname of library containing Installation Exit Module" field.

   Because the library must be an authorized library, the library must be defined in your installation's IEAAPFxx member.

4. If any of the control statements contain the CLEAR keyword, specify YES in the Special Secure Mode field. Otherwise, ICSF does not have to be in special secure mode, and you should specify NO in the Special Secure Mode field.

5. After you specify the necessary information, you can either:

   - Enter S to submit the job.

     KGUP creates the job stream and automatically submits the job to run the program.

   - Enter E to edit the job.

     KGUP creates the job stream and then displays the job stream on a panel in ISPF edit mode. Figure 244 on page 269 shows an example of a panel in ISPF edit mode that contains a job stream to run KGUP. When ICSF creates the job stream, ICSF defines the data sets that KGUP uses in the job. It defines these data sets according to the information you specified on the Specify KGUP Data Sets Panel. Refer to Figure 241 on page 266.

     a. On this panel, you can view the job stream ICSF created and make any necessary changes to the job stream.

     b. To submit your job with the changes, you must use the TSO SUBMIT command from the edit session. Type SUBMIT on the command line and press ENTER to submit the job and run KGUP.

     c. To return to the Set KGUP JCL Job Card panel without submitting the job stream, press END.

        The job stream is not saved after you leave this panel.

```
ISREDDE - SYS88218.T095045.RA000.LARSON.R0000002 ------------ COLUMNS 001 072
COMMAND ===> _                                                SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
000001 //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C
000002 //*
000003 //*
000004 //*
000005 //KGUP     EXEC PGM=CSFKGUP,PARM=('NOSSM')
000006 //CSFCKDS  DD   DSN=LARSON.TEST.CSFCKDS,
000007 //              DISP=OLD
000008 //CSFIN    DD   DSN=LARSON.CSFIN.TESTDS1P(TEST),
000009 //              DISP=OLD
000010 //CSFDIAG  DD   SYSOUT=*
000011 //CSFKEYS  DD   DSN=LARSON.TEST.CSFKEYS,
000012 //              DISP=OLD
000013 //CSFSTMNT DD   DSN=LARSON.TEST.CSFSTMNT,
000014 //              DISP=OLD
****** *************************** BOTTOM OF DATA ***************************
```

Figure 244. KGUP JCL Set for Editing and Submitting (Files Exist)

Example of a KGUP Job Stream with Existing Data Sets

The KGUP job stream in Figure 244 is an example of a job stream in which the data sets already exist.

In the EXEC statement of the job stream that ICSF created, the PGM parameter specifies that the job run KGUP. The PARM parameter notifies KGUP whether special secure mode is enabled. The keyword SSM indicates that the mode is enabled, and NOSSM indicates that the mode is not enabled.

The data definition (DD) statements identify the data sets that KGUP uses while processing. ICSF uses the names you provide on the Specify KGUP Data Sets panel. The cryptographic key data set (CSFCKDS) and the control statement input data set (CSFIN) have to exist before ICSF can generate the job stream. The other data sets do not have to already exist. In the example that is shown on this panel, all the data sets existed before ICSF created the job stream.

On the DD statements, the DSN parameter specifies the data set name. ICSF uses the name you provide on the Specify KGUP Data Sets panel for the data set name. The DISP parameter indicates the data set's status. On this panel, all the data sets existed before ICSF created this job stream, therefore the job stream indicates a status of OLD for the data sets.

In Figure 244, the DD statement for the diagnosis data set (CSFDIAG) is different from the other DD statements. The SYSOUT=* parameter specifies that ICSF print the data set on the output listing.

Note: You can change the default values that are used with the job control language such as the record format and record length by changing the outline file, CSFSAJ30. The information appears in the front of CSFSAJ30. CSFSAJ30 resides in the ICSF skeleton library.

Example of a KGUP Job Stream with Non-Existing Data Sets

Figure 245 shows an example of a panel in ISPF edit mode that contains a KGUP job stream where certain data sets did not exist previously.

```
ISREDDE - SYS88218.T095045.RA000.LARSON.R0000003 ------------- COLUMNS 001 072
COMMAND ===> _                                                 SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
000001 //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C
000002 //*
000003 //*
000004 //*
000005 //KGUP     EXEC PGM=CSFKGUP,PARM=('NOSSM')
000006 //CSFCKDS  DD   DSN=LARSON.TEST.CSFCKDS,
000007 //              DISP=OLD
000008 //CSFIN    DD   DSN=LARSON.CSFIN.TESTDS2P(TEST2),
000009 //              DISP=OLD
000010 //CSFDIAG  DD   DSN=LARSON.TEST.CSFDIAG,
000011 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000012 //              DCB=(RECFM=FBA,LRECL=133,BLKSIZE=13300),
000013 //              SPACE=(TRK,(220,10),RLSE)
000014 //CSFKEYS  DD   DSN=LARSON.TEST.CSFKEYS,
000015 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000016 //              DCB=(RECFM=FB,LRECL=208,BLKSIZE=3328),
000017 //              VOL=SER=TSO001,SPACE=(TRK,(60,10),RLSE)
000018 //CSFSTMNT DD   DSN=LARSON.TEST.CSFSTMNT,
000019 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000020 //              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200),
000021 //              SPACE=(TRK,(60,10),RLSE)
****** **************************** BOTTOM OF DATA ****************************
```

Figure 245. KGUP JCL Set for Editing and Submitting (Files Do Not Exist)

The job stream contains information to create the diagnosis data set (CSFDIAG), key output data set (CSFKEYS), and the control statement output data set (CSFSTMNT) that did not previously exist. On the DISP parameter, the CATLG keyword specifies that you want the data set cataloged when the job ends normally and when the job ends abnormally. The unit parameter indicates the device you want the data set to reside on. The DCB parameter specifies the necessary data control block information such as the record format (RECFM), record length (LRECL) and block size (BLKSIZE).

When you submit the job, KGUP performs the functions you specified on the control statements. The functions KGUP performs change the CKDS. You can view the diagnostics data set to know whether KGUP successfully processed the control statements.

Refreshing the Current CKDS Using the ICSF Panels

KGUP processing affects keys that are stored on a disk copy of the CKDS. You specify the name of the data set when you submit the KGUP job. For information on specifying the disk copy of the CKDS for KGUP processing, see “Specifying Data Sets Using the ICSF Panels” on page 264.

ICSF functions use an in-storage copy of the CKDS. To make the changes caused by the KGUP processing active, you replace the in-storage copy of the CKDS with the disk copy that the KGUP processing changed. You refresh the current copy of the CKDS with the changed disk copy of the CKDS.

1. To access the panels to refresh the current CKDS, choose option 4 on the Key Administration panel, as shown in Figure 246 on page 271.

```
CSFSAM00 ----------------- OS/390 ICSF - Key Administration ---------------
OPTION ===> 4


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 246. Selecting the Refresh Option on the Key Administration Panel

The Refresh in-storage CKDS panel appears. See Figure 247.

```
CSFSAE40 ------------------- OS/390 ICSF - Refresh in-storage CKDS --------
COMMAND ===> _

  Enter the Cryptographic Key Data Set (CKDS) to be loaded.

  Cryptographic Keys ===> TEST.CSFCKDS_____________________________


  Press ENTER to refresh the in-storage copy of CKDS
  Press END   to exit to previous panel
```

Figure 247. Refresh In-Storage CKDS

2. Enter the name of the disk copy of the CKDS to replace the current in-storage copy.

   The name of the CKDS that you chose when you specified data sets for KGUP processing on the Specify KGUP Data Sets panel, automatically appears on this panel. If you change the data set name on this panel, the data set name on the Specify KGUP Data Sets panel also changes. Refer to Figure 241 on page 266 for an example of the Specify KGUP Data Sets panel.

3. Press ENTER to replace the in-storage copy of the CKDS with the disk copy.

   Applications that are running on ICSFare not disrupted. A message that stating that the CKDS was refreshed appears on the right of the top line on the panel.

   ICSF performs a MAC verification on the records before reading the CKDS into storage. If a record fails the MAC verification, the record is not loaded into storage. The operator receives a message indicating the key label and type for that record.

   Any partial keys that may exist when you enter keys manually from the keypad (on a bipolar processor) are also not loaded into storage. For a description of how to use the keypad to enter keys, see “Entering Operational Keys” on page 186.

4. Press END to return to the Key Administration Panel.

Note: If you restart ICSF, the name of the disk copy that you specify in the CKDSN installation option is read into storage.

Scenario of Two ICSF Systems Establishing Initial Transport Keys

This scenario describes how two ICSF systems, System A and System B, establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 248.

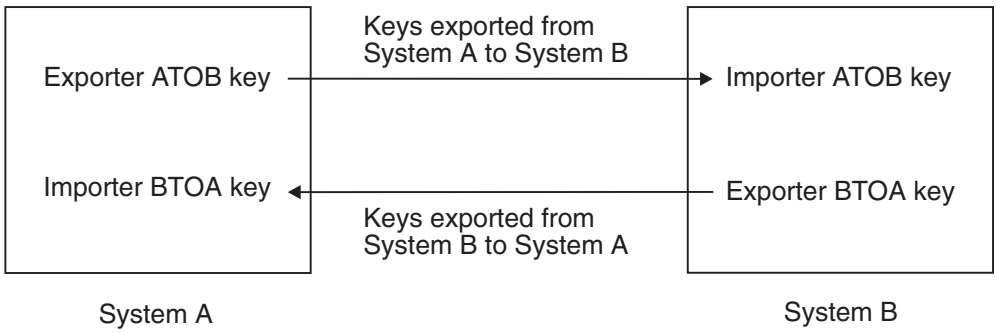

Figure 248. Key Exchange Establishment between Two ICSF Systems

The systems can use these importer and exporter keys during key exchange. First the ICSF administrators at the two locations establish the complementary transport keys to send keys from System A to System B. These keys are the Exporter ATOB key at System A and the Importer ATOB key at System B.

The ICSF administrator at System A submits the following control statement to System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR
```

KGUP processes this control statement to generate the Exporter ATOB key and places the key in System A's CKDS. KGUP creates a record containing the clear key created for the system, and that record is written to the CSFKEYS data set. This key value must be used to create a control statement like the following.

```
ADD  LABEL(ATOB)  TYPE(IMPORTER)  CLEAR,
KEY(B2403EF8125A036F,239AC35A72941EF2)
```

System A can send this control statement to System B, and System B can create the Importer ATOB key. The key value in this control statement is the clear value of the Exporter ATOB key. System A does not send this control statement to System B over the network, because the key value is a clear key value. System A has a courier deliver the control statement to System B.

The administrator at System B submits the control statement to its KGUP. KGUP processes the control statement to create the ATOB importer key. The ATOB exporter key at system A and the ATOB importer key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from System A to System B. When System A sends a key to System B it enciphers the key using the ATOB exporter key. When System B receives the key, System B deciphers the key using the ATOB importer key.

Then the ICSF administrators at the two locations establish the complementary transport keys to send keys from System B to System A. These keys are the Importer BTOA key at System A and the Exporter BTOA key at System B.

The ICSF administrator at System A submits the following control statement to System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  TRANSKEY(ATOB)
```

KGUP processes this control statement to generate the Importer BTOA key and places the key in System A's CKDS. KGUP also creates the following control statement and places the statement in the control statement output data set.

```
ADD  LABEL(BTOA)  TYPE(EXPORTER)  TRANSKEY(ATOB),
KEY(AF04C35A7F1C9636,03CBB854653A0BCF)
```

System A can send this control statement to System B and System B can use the statement to create the Exporter BTOA key. The key value in this control statement is the value of the Importer BTOA key enciphered under the Exporter ATOB key. System A can send this control statement to System B over the network, because the key value is enciphered.

The ICSF administrator at System B submits the control statement to its KGUP. The program processes the control statement to generate the Exporter BTOA key. The Importer BTOA key at System A and the Exporter BTOA key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from System B to System A. When System B sends a key to System A, System B enciphers the key using the Exporter BTOA key. When System A receives the key, System A deciphers the key using the Importer BTOA key.

Using these procedures two pairs of complementary transport keys are established at each facility to allow key exchange between the two facilities.

Notes:

1. During these procedures, the special secure mode at each system must be enabled, while KGUP is generating or receiving clear key values.
2. The ICSF administrator at System A can submit in the same KGUP job both the ADD control statements meant for processing at System A.
3. The ICSF administrator at System B can submit in the same KGUP job both the ADD control statements meant for processing at System B.

Scenario of an ICSF System and a CUSP or PCF System Establishing Initial Transport Keys

This scenario describes how an ICSF system and a CUSP or PCF system establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 249 on page 274.

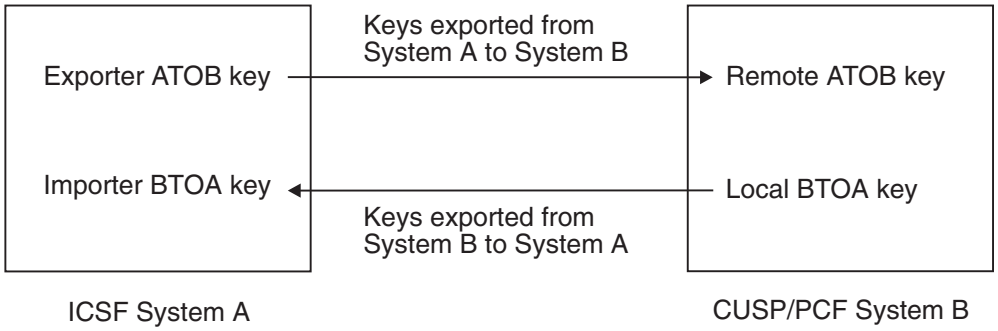

Figure 249. Key Exchange Establishment between an ICSF System and a PCF/CUSP System

The systems can use these importer and exporter keys during key exchange.

First the ICSF administrators at the two locations establish the complementary transport keys to send keys from ICSF System A to CUSP/PCF System B. These keys are the Exporter ATOB key at ICSF System A and the Remote ATOB key at CUSP/PCF System B.

The ICSF administrator at ICSF System A submits the following control statement to ICSF System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR  NOCV
```

Note: If System B is a PCF system, the ICSF administrator must also specify the keyword SINGLE on this control statement.

KGUP processes this control statement to generate the Exporter ATOB key and places the key in ICSF System A's CKDS. KGUP also creates the following control statement and places the statement in the control statement output data set.

```
ADD  LABEL(ATOB)  TYPE(IMPORTER)  CLEAR,
KEY(B2403EF8125A036F,239AC35A72941EF2)  NOCV
```

ICSF System A needs to send this control statement to CUSP/PCF System B so that CUSP/PCF System B can create the Remote ATOB key. The key value in this control statement is the clear value of the ATOB exporter key. ICSF System A does not send this control statement to CUSP/PCF System B over the network, because the key value is a clear key value. ICSF System A has a courier deliver the control statement to System B.

The administrator at either system must change the ICSF control statement format into the CUSP/PCF control statement format. The administrator could also use information from the key output data set to create the CUSP/PCF control statement.

The control statement submitted at CUSP/PCF System B would have the following syntax:

```
REMOTE ATOB,KEY=B2403EF8125A036F,IKEY=239AC35A72941EF2,ADD
```

The administrator at CUSP/PCF System B submits the control statement to the CUSP/PCF key generation utility program, which processes the control statement to create the ATOB Remote key. The ATOB Exporter key at System A and the ATOB Remote key at CUSP/PCF System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from ICSF System A to CUSP/PCF System B. When ICSF System A sends a key to CUSP/PCF System B, System A enciphers the key using the ATOB exporter key. When CUSP/PCF System B receives the key, CUSP/PCF System B deciphers the key using the Remote ATOB key.

Then the ICSF administrators at the two locations establish the complementary transport keys to send keys from CUSP/PCF System B to ICSF System A. These keys are the Importer BTOA key at ICSF System A and the Local BTOA key at CUSP/PCF System B.

The ICSF administrator at ICSF System A submits the following control statement to ICSF System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  CLEAR  NOCV
```

KGUP processes this control statement to generate the Importer BTOA key and places the statement in ICSF System A's CKDS. KGUP also creates the following control statement and places the statement in the control statement output data set.

```
ADD  LABEL(BTOA)  TYPE(EXPORTER)  CLEAR
KEY(6F3463CA3FBC0626,536B1864954A0B1F)  NOCV
```

System A can send this control statement to System B, which can then use it to create the Local BTOA key. The key value in this control statement is the clear value of the BTOA importer key. ICSF System A does not send this control statement to CUSP/PCF System B over the network, because the key value is a clear key value. ICSF System A has a courier deliver the control statement to CUSP/PCF System B.

The administrator at either system must change the ICSF control statement format into the CUSP/PCF control statement format. The administrator can also use information from the key output data set to create the CUSP/PCF control statement.

The control statement submitted at CUSP/PCF System B would have the following syntax:

```
LOCAL BTOA,KEY=6F3463CA3FBC0626,IKEY=536B1864954A0B1F,ADD
```

The administrator at CUSP/PCF System B submits the control statement to the CUSP/PCF key generation utility program, which processes the control statement to generate the Local BTOA key. The Importer BTOA key at ICSF System A and the Local BTOA key at CUSP/PCF System B are complementary keys.

Note: A single CUSP/PCF key generation control statement can be used to generate both Remote and Local BTOA keys, also called a CROSS key pair.

```
CROSS BTOA,KEYLOC=6F3463CA3FBC0626,IKEYLOC=536B1864954A0B1F,
          KEYREM=B2403EF8125A036F,IKEYREM=239AC35A72941EF2,ADD
```

This procedure creates a pair of complementary transport keys for keys sent from CUSP/PCF System B to ICSF System A. When CUSP/PCF System B sends a key to ICSF System A, System B enciphers the key, using the Local BTOA key. When ICSF System A receives the key, ICSF System A deciphers the key, using the Importer BTOA key.

By these procedures, two pairs of complementary transport keys are established at each location so that the two systems can exchange keys.

Note: During these procedures, the special secure mode should be enabled while KGUP generates or receives clear key values.

Scenario of an ICSF System and TSS Establishing Initial Transport Keys

This scenario describes how an ICSF system and a Transaction Security System (TSS) establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 250.

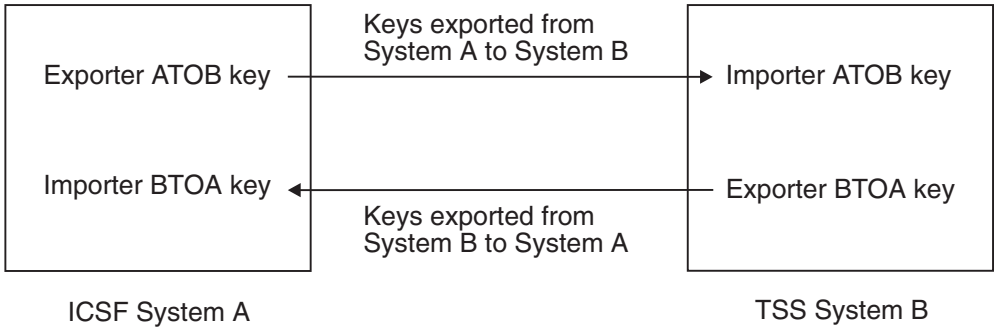

Figure 250. Key Exchange Establishment between a TSS System and an ICSF System

The systems can use these importer and exporter keys during key exchange. First, the ICSF System A administrator and the TSS System B administrator establish the complementary transport keys to send keys from ICSF System A to TSS System B. These keys are the Exporter ATOB key at System A and the Importer ATOB key at System B.

The ICSF administrator at System A submits the following control statement to System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR
```

KGUP processes this control statement to generate the Exporter ATOB key and places the key in System A's CKDS. KGUP creates a record containing the clear key created for the system, and that record is written to the CSFKEYS data set. ICSF System A then sends this clear key to TSS System B. Because the key value is in the clear, System A has a courier deliver the key, rather than sending it over the network.

The TSS administrator at System B uses the Secure_Key_Import verb to import the ATOB importer key, because the key value is in the clear. The administrator can then use the Key_Record_Create and the Key_Record_Write verbs to place the key in TSS key storage. The ATOB exporter key at ICSF system A and the ATOB importer key at TSS System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from ICSF System A to TSS System B. When ICSF System A sends a key to TSS System B, it enciphers the key using the ATOB exporter key. When TSS System B receives the key, it deciphers the key using the ATOB importer key.

Next, the administrators at the two facilities establish the complementary transport keys to send keys from TSS System B to ICSF System A. These keys are the Importer BTOA key at ICSF System A and the Exporter BTOA key at TSS System B. The ICSF administrator at System A submits the following control statement to System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  TRANSKEY(ATOB)
```

KGUP processes this control statement to generate the Importer BTOA key and places the key in System A's CKDS. The ICSF System A administrator can send this key to the TSS System B over the network, because the key value is enciphered.

The TSS administrator at System B uses Key_Import, Key_Record_Create, and the Key_Record_Write verbs to import the key and place it in TSS key storage. The Importer BTOA key at System A and the Exporter BTOA key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from TSS System B to ICSF System A. When TSS System B sends a key to ICSF System A, TSS System B enciphers the key using the Exporter BTOA key. When ICSF System A receives the key, it deciphers the key using the Importer BTOA key.

Using these procedures two pairs of complementary transport keys are established at each location to allow key exchange between the two systems.

Notes:

1. During these procedures, the special secure mode must be enabled on ICSF while KGUP is generating or receiving clear key values, and the Secure_Key_Import verb must be enabled on TSS to receive clear keys.
2. The ICSF administrator at System A can submit in the same KGUP job both the ADD control statements meant for processing at System A.

Chapter 9. Viewing System Status

You must define installation options, and any installation exits and installation-defined callable services to ICSF. Using the ICSF panels, you can view how these options and programs are currently defined. During master key management, you change the status of the key storage registers that contain key parts and the master keys. You can using the ICSF panels to view the status of these hardware registers.

Installation options enable you to specify certain modes and conditions on ICSF. For example, if your installation specifies `YES` for the SSM option, you can enable special secure mode. You specify installation options in the installation options data set. The ICSF startup procedure, specifies the installation options data set to be used for that start of ICSF. The options become active, when you start ICSF. You can use the panels to view each installation option and its current value.

ICSF provides invocation points where you can use installation exits to perform processing that is specific to your installation. For example, ICSF provides a preprocessing and postprocessing exit invocation for each ICSF callable service. You can write and define an exit to set return codes at postprocessing of a callable service.

You must define each installation exit in the installation options data set. You define the ICSF name for the exit, the load module name of the exit, and the action ICSF takes if the exit fails. You can use the panels to view the ICSF name for each exit invocation. For a defined exit, you view the exit's load module name and fail options.

ICSF provides callable services to perform cryptographic functions. You can write a callable service to perform a function unique to your installation. In the installation options data set, you must define each installation-defined callable service. You specify a number to identify the service to ICSF, and you specify the load module that contains the service. You can use the panels to view the number and module name for each installation-defined callable service.

When you check the status of an installation option, an installation exit, or an installation-defined callable service, you may decide to change how you defined the option or program. You must change the information in the installation options data set and restart ICSF to activate the change.

When you enter and activate a DES master key, you change the status of the registers and the physical, or virtual, key switch positions on the hardware. The cryptographic facility contains several key registers. The key part register stores key parts during key entry. The master key register contains the active DES master key. The auxiliary key register contains either the old DES master key or a new DES master key before it is activated and transferred to the master key register. There are also registers for the PKA master keys. The physical, or virtual, key switch must be in different positions while you enter different key parts. When you enter a master key, the Cryptographic Coprocessor Feature, the PCI Cryptographic Coprocessor Feature or ICRF, calculates a verification pattern and a hash pattern for the master key. You can use these patterns to identify master keys.

You can use the panels to display the conditions of the key registers and the verification pattern and hash patterns for the master keys. You may use this information for master key management. You can also check hardware status when you manually enter a key into the cryptographic key data set (CKDS).

Displaying Installation Options

To display installation options:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 251.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 3

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 251. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options and Status panel appears. Refer to Figure 252.

```
CSFSOP00 ----------- OS/390 ICSF - Installation Options and Status --------
OPTION ===> 1

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  STATUS   -  Display Hardware Status
  3  EXITS    -  Display Installation exits and exit options
  4  SERVICES -  Display Installation Defined Services
```

Figure 252. Installation Options and Status Panel

2. Select option 1, Options, on the Installation Options Status panel.

   The Installation Option Display panel, which is shown in Figure 253 on page 281, appears.

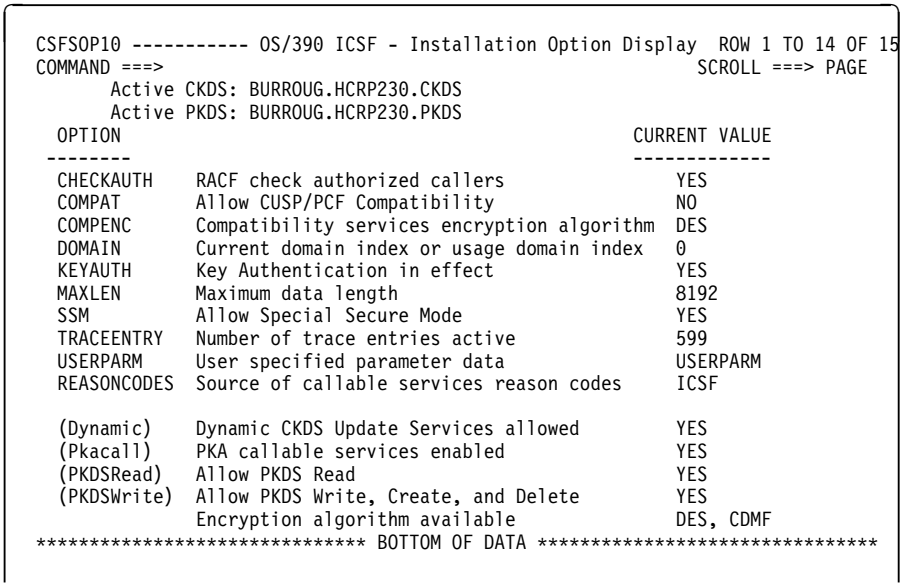

Figure 253. Installation Options Display Panel

This panel displays the keyword for each installation option, a brief description, and the current value of the option. For example, the MAXLEN option, which specifies the maximum length of data for any callable service request, is currently set at 8192 characters of data.

You may want to change the current value of an installation option. To change and activate an installation option, you must change the option value in the installation options data set and restart ICSF. For integrity reasons, a change of the DOMAIN option also requires a re-IPL of MVS. For a complete description of these installation options and the installation options data set, see the *OS/390 ICSF System Programmer's Guide*.

The installation options data set that the system uses at ICSF startup contains keywords and their values which specify certain installation options. On this panel, you can view the following options and their values:

Active CKDS: (data-set-name)
This specifies the name of the CKDS the system uses during the startup of ICSF. On the Installation Options Display panel, this data set name is called the active CKDS.

Active PKDS: (data-set-name)
This specifies the name of the PKDS the system uses during the startup of ICSF.

CHECKAUTH(YES or NO)
Indicates whether ICSF performs access control checking of Supervisor State and System Key callers. If you do not specify the CHECKAUTH option, the default is CHECKAUTH(NO).

Value	Indication
YES	ICSF checks Supervisor State and System Key callers.

NO ICSF does not check Supervisor State and System Key callers, resulting in significant performance enhancement for applications that use ICSF callable services.

COMPAT(YES, NO, or COEXIST)

Indicates whether ICSF is running in compatibility mode, noncompatibility mode, or coexistence mode with the Cryptographic Unit Support Program (CUSP) or Programmed Cryptographic Facility (PCF). If you do not specify the COMPAT option, the default value is COMPAT(NO).

Value	Indication
YES	ICSF is running in compatibility mode, which means you can run CUSP and PCF applications on ICSF because ICSF supports the CUSP and PCF macros in this mode. You do not have to reassemble CUSP and PCF applications to do this. However, you cannot start CUSP or PCF at the same time as ICSF on the same MVS system.
NO	ICSF is running in noncompatibility mode, which means that you run CUSP applications on CUSP, PCF applications on PCF, and ICSF applications on ICSF. You cannot run CUSP or PCF applications on ICSF, because ICSF does not support the CUSP and PCF macros in this mode. You can start CUSP or PCF at the same time as ICSF on the same OS/390 operating system. You can start ICSF and then start CUSP or PCF or you can start CUSP or PCF and then start CSF. You should use noncompatibility mode unless you are migrating from CUSP or PCF to ICSF.
COEXIST	ICSF is running in coexistence mode. In this mode you can run a CUSP or PCF application on CUSP or PCF, or you can reassemble the CUSP or PCF application to run on ICSF. To do this, you reassemble the application against coexistence macros that are shipped with ICSF. In this mode, you can start CUSP or PCF at the same time as ICSF on the same MVS system.

COMPENC(DES or CDMF)

On a system where both DES and CDMF encryption algorithms are available, the COMPENC setting indicates the encryption algorithm for the PCF/CUSP compatibility CIPHER macro.

Value	Indication
DES	The CIPHER macro uses the DES encryption algorithm.
CDMF	The CIPHER macro uses the CDMF encryption algorithm.

DOMAIN(n)

Allows you to access one of several separate sets of master key registers. Each domain contains the following master key registers:

- A master key register that contains the active DES master key
- An auxiliary master key register that holds either the old or new master key
- A PKA key management master key register
- A PKA signature master key register
- If you have PCICC, there are SYM-MK and ASYM-MK registers.

You can use domains to have separate master keys for different purposes.

You can use domains in basic mode or with PR/SM logical partition (LPAR) mode. In basic mode, you access only one domain at a time. You can specify a different master key in each domain. For example, you might have one master key for production operations and a different master key for test operations. In LPAR mode, you can have a different domain for each partition. The number you specify is the number of the domain to be used for this start of ICSF.

On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise you use the Crypto page of the Customize Activation Profile to assign a usage domain index (0 to 15) to a logical partition and enable cryptographic functions. The DOMAIN number you specify in the installation options data set while running in a partition must be the same number as the usage domain index specified for the partition on the Crypto page. For more information about logical partitions, see the *S/390 PR/SM Planning Guide*.

On a bipolar processor, you specify a master key index for each partition on the PR/SM LPSEC Logical Partition Security frame which displays on the system console. The DOMAIN number you specify while running in a partition must be the same number as the master key index specified for the partition on the LPSEC frame. If you do not specify the DOMAIN option, the default is DOMAIN(0). For more information about logical partitions, see the *IBM ES/9000 and ES/3090 Processor Complex PR/SM Planning Guide*. For information about the number of domains your processor or server supports, see the *IBM ES/3090 Processor Complex Recovery Guide*.

To change and activate the other installation options, you must restart ICSF. In compatibility or coexistence mode, to change and activate the DOMAIN option, you must also re-IPL MVS. A re-IPL ensures that a program does not use a key that has been encrypted under a different master key to access a cryptographic service.

KEYAUTH(YES or NO)

Indicates whether or not ICSF should authenticate a key entry after it retrieves one from the in-storage cryptographic key data set. If you do not specify the KEYAUTH option, the default value is KEYAUTH(NO).

Value	Indication
YES	ICSF authenticates the keys. ICSF generates a message authentication code (MAC) for each key entry in the CKDS whenever it creates or updates the key entry. ICSF also performs a MAC verification to ensure that the entry was not changed.
NO	ICSF does not authenticate keys retrieved from the in-storage CKDS. ICSF gains a small enhancement of performance.

MAXLEN(n)

Defines the maximum length of characters in a text string for some callable service request. n is a decimal value. For example, this option defines the maximum length of the text the encipher service will encrypt for each call. The range of valid values is 1024 through 2147843647.

If you do not specify the MAXLEN option, the default value is MAXLEN(65535).

SSM(YES or NO)

Indicates whether or not an installation can ever enable special secure mode during the running of ICSF. This mode lowers the security of your system. It allows you to input clear keys by using KGUP, produce clear PINs, and use the

Secure Key Import callable service. If you do not specify the SSM option, the default value is SSM(NO).

Value	Indication
YES	Special secure mode is enabled. For OS/390 ICSF, SSM(YES) must be specified in order to use KGUP or the Secure Key Import callable service on either the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise. On bipolar processors, in addition to specifying SSM(YES), you must also set a physical key position on the key storage unit.
NO	You cannot enable the special secure mode.

TRACEENTRY(n)
Specifies the number, `n`, of trace buffers to allocate for ICSF tracing. `n` is a decimal value. The range of valid values is 100 through 10000.

If you do not specify the TRACEENTRY option, the default value is TRACEENTRY(1000).

USERPARM(value)
Displays the value of an 8-byte field that is defined for installation use. ICSF stores this value in the CCVT_USERPARM field of the Cryptographic Communication Vector Table (CCVT). An application program or installation exit can examine this field and use it to set system environment information.

REASONCODES(ICSF or TSS)
Specifies which set of reason codes the application interface returns.

Value	Indication
ICSF	ICSF reason codes are returned.
TSS	TSS reason codes are returned.

ICSF is the default.

(Dynamic)(YES or NO)
Specifies whether the dynamic CKDS update services are currently allowed. You can allow or disallow these services by choosing option 7, USERCNTL, on the Primary Menu Panel to access the User Control Functions panel.

Value	Indication
YES	The dynamic CKDS update services are allowed.
NO	The dynamic CKDS update services are not allowed.

(Pkacall)(YES or NO)
Specifies whether the use of PKA callable services is currently allowed. You can allow or disallow these services by choosing option 7, USERCNTL, on the Primary Menu Panel to access the User Control Functions panel.

Value	Indication
YES	The PKA callable services is allowed.
NO	The PKA callable services is not allowed.

(PKDSRead)(YES or NO)
Specifies whether the use of PKDS Read callable service is currently allowed. You can allow or disallow these services by choosing option 7, USERCNTL, on the Primary Menu Panel to access the User Control Functions panel.

Value	Indication
YES	The PKDS Read callable service is allowed.
NO	The PKDS Read callable service is not allowed.

(PKDSWrite)(YES or NO)
Specifies whether the use of PKDS Write callable service is currently allowed. You can allow or disallow these services by choosing option 7, USERCNTL, on the Primary Menu Panel to access the User Control Functions panel.

Value	Indication
YES	The PKDS Write callable service is allowed.
NO	The PKDS Write callable service is not allowed.

Encryption algorithm available (DES or DES,CDMF, or CDMF)
Specifies the type of encryption algorithm that is permitted on the current system. This value *cannot* be set or changed; it can only be displayed.

Value	Indication
DES	Only the DES encryption algorithm is available.
DES, CDMF	Both the DES and CDMF encryption algorithms are available.
CDMF	Only the CDMF encryption algorithm is available.

For more information about the ICSF startup procedure and installation options, see the *OS/390 ICSF System Programmer's Guide*. At any time while you are running ICSF, you can check the current value of these installation options.

The installation exits and installation-defined callable services are also specified in the installation options data set, but they are not displayed on this panel. For a description of how to display the installation exit information, see “Displaying Installation Exits” on page 303. For a description of how to display installation-defined callable service information, see “Displaying Installation-Defined Callable Services” on page 309.

Displaying Hardware Status

You can use the ICSF panels to view the status of the cryptographic coprocessor key registers, the master key verification patterns, and other information about the cryptographic hardware.

To display hardware status:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 254 on page 286

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 3

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 254. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options and Status panel appears. Refer to Figure 255.

```
CSFSOP00 ----------- OS/390 ICSF - Installation Options and Status --------
OPTION ===> 2

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  STATUS   -  Display Hardware Status
  3  EXITS    -  Display Installation exits and exit options
  4  SERVICES -  Display Installation Defined Services
```

Figure 255. Installation Options and Status Panel

2. Select option 2, Status, on the Installation Options and Status panel.

   The panels that appear depend on your cryptographic hardware. To continue, select the type of cryptographic hardware for which you are requesting status and turn to that location in the manual.

   - For status information on S/390 Cryptographic Coprocessor Features, continue with "Displaying S/390 Cryptographic Coprocessor Feature Hardware Status" on page 287.
   - For status information on PCI Cryptographic Coprocessors, continue with "Displaying PCI Cryptographic Coprocessor Hardware Status" on page 292.
   - For status information on ICRFs, continue with "Displaying ICRF Hardware Status" on page 297.

Some servers allow you to partition the processor unit into two sides (side 0 and side 1). The individual central processors, processor storage arrays, and the channel subsystems are associated with side 0 or side 1. Such a processor is called a *multiprocessor model* and may have up to two coprocessors. If it has two, one is attached to each side. The unit on Side 0 is called Coprocessor 0, and the one on Side 1 is called Coprocessor 1.

If two coprocessors exist, the panel shows status for both. If only one cryptographic coprocessor exists, the panel shows just the status for that unit. The fields for the second cryptographic coprocessor are blank.

When viewing this panel, you may realize that you have to reenter a master key in a coprocessor. For information about entering a master key, see either Chapter 5, Managing Master Keys on the S/390 Enterprise Servers and the S/390 Multiprise, Chapter 6, Managing Master Keys on the S/390 Enterprise Server with PCI

Cryptographic Coprocessors or Chapter 7, Managing the Master Key and Operational Keys on the ES/9000-9021 (Bipolar) Processor.

PR/SM Considerations: If you are running with PR/SM in logical partition mode, your partition may not have access to the KSU. If your partition does not have access to the KSU, the Hardware Status panel states that the physical key switch may be incorrect. The physical key switch position states that the switch is in the NORMAL position, even if the physical switch or logical switch is in another position. However, the other information on the panel is correct. To access the KSU, you must either enable your partition or switch to an enabled partition. On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, you can enable key entry on the Change LPAR Crypto page for your partition. On these servers multiple partitions can have access to the KSU at any time. On a bipolar processor, only one partition at a time can access the KSU. The partition's KE field on the PR/SM LPSEC Logical Partition Security frame must be enabled.

For more information about displaying KSU status in LPAR mode, see Appendix C, PR/SM Considerations during Key Entry.

Displaying S/390 Cryptographic Coprocessor Feature Hardware Status

When you select the Status option on the Installation Options and Status panel, the Coprocessor Status Display panel appears. Refer to Figure 256.

```
CSFMKP01 ----------- OS/390 ICSF - Coprocessor Status Display--------
OPTION ===>

Enter the number of the desired option above.

  1  Cryptographic Coprocessor Feature Status

  2  PCI Cryptographic Coprocessor Status


Press ENTER to proceed.
Press END   to exit to previous menu.
```

Figure 256. Coprocesssor Status Display Panel

1. To display the status of the Cryptographic Coprocessor Feature, select option 1 and press ENTER.

   The Hardware Status Display panel appears. Refer to Figure 257 on page 288 and Figure 258 on page 288.

```
CSFMKP11 ----------- OS/390 ICSF - Hardware Status Display ----------------
OPTION ===>

                                                          CRYPTO DOMAIN: 0

REGISTER STATUS               COPROCESSOR C0          COPROCESSOR C1
                                                                MORE:    +
  Crypto Module ID          : E589C39694407A60      : C39997A396F1407A
                            : 5D40C39997A396F0      : 605D40E589C39694
  Crypto CPs installed      : 1                     : 3
  Crypto CPs active         : 1                     : 3
  Key Part register         : DISABLED and EMPTY    : DISABLED and EMPTY
  New Master Key register   : EMPTY                 : EMPTY
  NMK verification pattern  :                       :
  Old Master Key register   : VALID                 : VALID
  OMK verification pattern  : EF569412CD91AB78      : EF569412CD91AB78
  Old/New Master Key register: 1F25A78BC88ED77A     : 1F25A78BC88ED77A
     hash pattern           : 827AD75B98FE1529      : 827AD75B98FE1529


Press ENTER to refresh the hardware status display.
Press END   to exit to the previous menu.
```

Figure 257. First Hardware Status Display Panel for the Cryptographic Coprocessor Feature

```
CSFMKP11 ----------- OS/390 ICSF - Hardware Status Display ----------------
OPTION ===>
                                                          CRYPTO DOMAIN: 0

REGISTER STATUS               COPROCESSOR C0          COPROCESSOR C1
                                                                MORE:    -
  Master Key register       : VALID                 : VALID
  MK verification pattern   : 1294ABCD5678EF91      : 1294ABCD5678EF91
  Master Key register       : DF3A50AE35466123      : DF3A50AE35466123
     hash pattern           : 96EF557E8BD074C1      : 96EF557E8BD074C1
  PKA Key Management Master : 25A76B6678A32249      : 25A76B6678A32249
   Key register hash pattern: DF3A50AE35466123      : DF3A50AE35466123
  PKA Signature Master Key  : 5624E3298A881254      : 5624E3298A881254
     register hash pattern  : DF3A50AE35466123      : DF3A50AE35466123
  Special Secure Mode       : ENABLED               : ENABLED
  Crypto Configuration      : F0F0F0F0F0F0F0F0      : F0F0F0F0F0F0F0F0
   Control                  : F0F0F0F0F0F0F0F0      : F0F0F0F0F0F0F0F0
  Environment Control Mask  : 74774747              : 74774747

Press ENTER to refresh the hardware status display.
Press END   to exit to the previous menu.
```

Figure 258. Second Hardware Status Display Panel for the Cryptographic Coprocessor Feature

On these panels, you can view the status of the Cryptographic Coprocessor Feature. You can check whether a unit is active and whether its registers are in the correct state.

2. Press ENTER to refresh the panels with any changes to the coprocessor status that have occured since you accessed the panel.

The hardware status fields on this panel contain the following information:

CRYPTO DOMAIN
This field displays the value that is specified for the DOMAIN keyword in the installation options data set at ICSF startup. This is the domain in which your

system is currently working. It specifies which one of several separate sets of master key registers you can currently access. A system programmer can use the DOMAIN keyword in the installation options data set to specify the domain value to use at ICSF startup. For more information about the DOMAIN installation option, see 282.

REGISTER STATUS

The Register Status fields on the panel give you the following information about the cryptographic coprocessors in your processor complex.

The field directly below the coprocessor number displays the status. The values that can appear in this field are as follows:

Value	Indication
<blank>	The coprocesssor is fully operational.
STANDBY	The coprocessor is in either the **Standby** or **Zeroize** mode.
TAMPER DETECTED	A tamper has been detected.
HARDWARE FAILURE	A permanent hardware error has been detected.

Crypto Module ID

This field displays the unique 128-bit value that was generated for this crypto module during the manufacturing process.

Crypto CPs Installed

This field displays the processor numbers of the CPs that have a cryptographic feature installed and are online to MVS.

Crypto CPs Active

This field displays the processor numbers of the CPs that have a cryptographic feature available and that can be used by ICSF.

Key Part Register

This field shows the states of the key part register in the cryptographic feature.

You can put the key part register in any of the following states:

State	Indication
ENABLED and EMPTY	A key register is in either the Enter NMK(1) or the Enter NMK(2) mode. You are accessing the correct ICSF panel, but have not yet entered the actual key part.
ENABLED and FULL	A key register is in either the Enter NMK(1) or the Enter NMK(2) mode. You are entering a key part into the key part register, but have not completed the panel path to move the key part into the new master register.
DISABLED and EMPTY	You have accessed the complete path of panels to enter a key part. ICSF has transferred the key part to the master key register, and returned the key switch to the Normal position.

New Master Key Register

This field shows the state of the new master key register.

This key register can be in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

The new master key is held in an auxiliary key register. This auxiliary key register can contain either a new master key or an old master key. Therefore, a new master key and the old master key cannot coexist.

NMK Verification Pattern

If the new master key register is FULL, the panel displays a verification pattern for the key. When you use the master key panels to enter a new master key, *record the verification pattern* that appears on the final panel. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using two cryptographic features, you must enter the same master key into both units. If the units have valid new master key register statuses, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Old/New Master Key register

This field shows the states of the old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

The old/new master key register is actually the auxiliary master key register. The auxiliary master key register can contain either the new master key or the old master key. Therefore a new master key and an old master key cannot coexist at the same time. If an old master key exists, it is lost when you enter a new one. Therefore, you should convert all your keys from under the old master key to under the current master key before you enter a new master key.

OMK Verification Pattern

If the old master key register is valid, the panel displays a verification pattern for the old master key.

Old/New Master Key Register Hash Pattern

If the auxiliary master key register contains a valid old or new master key, the hash pattern for it is displayed here.

Master Key Register
This field shows the states of the master key register.

State	Indication
EMPTY	You have never entered and set an initial master key on this coprocessor or the domain was zeroized.
VALID	You have entered a new master key on this coprocessor and chosen either the set or change option.

MK Verification Pattern
If the master key register is valid, the panel displays a verification pattern for the key. When you enter a new master key, *record the verification pattern* that appears on the panel. When the master key becomes active, you can compare the verification patterns to ensure that the one you entered and set is in the master key register.

If your system is using two Cryptographic Coprocessor Features, you enter the same master key into both units. If both units have valid master key register statuses, the MK verification patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the verification patterns that the Cryptographic Coprocessor Feature calculates appears in SMF record type 82.

Master Key Register Hash Pattern
If the master key register is valid, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using two Cryptographic Coprocessor Features, you enter the same master key into both units. If the sides have valid master key register statuses, the master key register hash patterns for each unit should match, because the patterns verify the same key.

PKA Key Management Master Key Register Hash Pattern
This field shows the state of the PKA key management master key register.

State	Indication
EMPTY	You have never entered and set an initial PKA key management master key. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
<hash pattern>	You have entered a PKA key management master key, and the hash pattern for the key register is shown here.

PKA Signature Master Key Register Hash Pattern
This field shows the state of the PKA signature master key register.

State	Indication
EMPTY	You have never entered and set an initial PKA signature master key. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.

<hash pattern> You have entered a PKA signature master key, and the hash pattern for the key register is shown here.

Special Secure Mode
This field shows if the special secure mode is enabled or disabled. Special secure mode is a lower form of security. This mode allows you to use KGUP to enter clear keys, produce clear PINs, use the secure key import callable service, and initialize the CKDS. On the S/390 G3 Enterprise Server, or higher or the S/390 Multiprise, special secure mode is enabled automatically when you send a KGUP request, provided that the SSM installation option is set to YES.

Crypto Configuration Control
The crypto configuration control contains controls to enable and disable all the major components of the crypto modules. This field shows the value of this control.

Environment Control Mask
The environment control mask contains controls for a subset of the components for each domain. This field shows the value of this control.

Displaying PCI Cryptographic Coprocessor Hardware Status

When you select the Status option on the Installation Options and Status panel, the Coprocessor Status Display panel appears. Refer to Figure 259.

```
CSFMKP01 ----------- OS/390 ICSF - Coprocessor Status Display--------
OPTION ===>

Enter the number of the desired option above.

  1  Cryptographic Coprocessor Feature Status

  2  PCI Cryptographic Coprocessor Status


Press ENTER to proceed.
Press END   to exit to previous menu.
```

Figure 259. Coprocesssor Status Display Panel

1. To display the status of the PCI Cryptographic Coprocessor, select option 2 and press ENTER.

   The PCICC Selection panel appears. Refer to Figure 260.

```
CSFMKP02 -------------- OS/390 ICSF - PCICC Selection ------------
OPTION ===> 1,3

  1. P00
  2. P01
  3. P02
  4. P03


Enter the number of one or two coprocessors to see the status of
specific coprocessor. Separate the numbers with a comma or a blank.

Press ENTER to see the status of all active coprocessors.

Press END   to exit to previous menu.
```

Figure 260. The PCICC Selection Panel

2. To see status of one or two PCI Cryptographic Coprocessor, enter their numbers (separated by a blank or a comma) and press ENTER.
3. To see status of all the PCI Cryptographic Coprocessors, press ENTER without entering any specific numbers.

   The Hardware Status Display panel appears. Refer to Figure 261.

```
CSFMKP12 ------------ OS/390 ICSF - Hardware Status Display ------------
OPTION ===>
                                                        CRYPTO DOMAIN: 0
                                                        MORE >
REGISTER STATUS                  COPROCESSOR P00     COPROCESSOR P02
 Serial Number                 : 41-00069            41-01030
 Status                        : ACTIVE              ONLINE
 New Symmetric-Keys Master Key : EMPTY               PART FULL
   Verification pattern        :                     2342352352352352
   Hash pattern                :                     A17B93C44D24681A
                               :                     806427AAC91221CC
 Old Symmetric-Keys Master Key : VALID               VALID
   Verification pattern        : 0123456789ABCDEF    0123456789ABCDEF
   Hash pattern                : 1972BB5791BB2430    1972BB5791BB2430
                               : 9691BDA1970BDAA2    9691BDA1970BDAA2
 Symmetric-Keys Master Key     : VALID               VALID
   Verification pattern        : CA6B408A02371B1D    CA6B408A02371B1D
   Hash pattern                : 41DF774FF81547D0    41DF774FF81547D0
                               : 090ABC4539727511    090ABC4539727511
 New Asymmetric-Keys Master Key: EMPTY               PART FULL
   Hash pattern                :                     234235236236234D
                               :                     5678567856785678
 Old Asymmetric-Keys Master Key: VALID               VALID
   Hash pattern                : 3456789012ADFECB    3456789012ADFECB
                               : ABCDEF7890123456    ABCDEF7890123456

 Asymmetric-Key New Master Key : VALID               EMPTY
   Hash pattern                : 1234123412412340
                               : 5678567856785678
Press ENTER to refresh the hardware status display.
Press END   to exit to previous menu.
```

Figure 261. The PCICC Selection Panel

The hardware status fields on this panel contain the following information:

CRYPTO DOMAIN
This field displays the value that is specified for the DOMAIN keyword in the installation options data set at ICSF startup. This is the domain in which your system is currently working. It specifies which one of several separate sets of master key registers you can currently access. A system programmer can use the DOMAIN keyword in the installation options data set to specify the domain value to use at ICSF startup. For more information about the DOMAIN installation option, see 282.

Serial Number
This field displays the unique serial number for the PCI Cryptographic Coprocessor.

Status – Active/Online

This field displays the status of the PCI Cryptographic Coprocessor.

State	Indication
ACTIVE	The verification pattern for the SYM-MK matches the verification pattern of the DES master key on the server's Cryptographic Coprocessor Feature. The hash pattern for the ASYM-MK matches the hash pattern of the Signature Master Key (SMK) register on the server's Cryptographic Coprocessor Feature. Requests for services can then be routed to either cryptographic coprocessor.
ONLINE	The PCI Cryptographic Coprocessor is online, but one or both of the master key verification patterns or hash patterns do not match those of the server's Cryptographic Coprocessor Feature. Requests for services cannot be routed to the PCI Cryptographic Coprocessor.
DISABLED	The PCI Cryptographic Coprocessor has been disabled by the TKE workstation.
DEACTIVATED	The PCI Cryptographic Coprocessor has been deactivated from the PCICC Management panel.
TEMP UNAVAILABLE	An unexpected error has been returned from the card. The system goes into recovery to try to reset the card. If the reset is successful, the card is usable again. The user will have to press ENTER to refresh the status.
HARDWARE ERROR	The reset from a TEMP UNAVAILABLE condition was not successful and the card is unusable.

New Symmetric-keys Master Key

This field shows the state of the symmetric-keys new master key register.

This key register can be in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial symmetric-keys master key, or you have just transferred the contents of this register into the symmetric-keys master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new symmetric-keys master key, but have not transferred it to the symmetric-keys master key register yet.

New Symmetric-Keys Master Key Verification Pattern

If the symmetric-keys new master key register is PART FULL or FULL, the panel displays a verification pattern for the key. When you use the master key panels to enter a new master key, *record the verification pattern* that appears

on the final panel. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new symmetric-keys master key register are the same.

New Symmetric-Keys Master Key Hash Pattern
If the new master key register is not empty, the panel displays a hash pattern for the new master key.

Old Symmetric-keys Master Key
This field shows the states of the symmetric-keys old master key register.

State	Indication
EMPTY	You have never changed the symmetric-keys master key and, therefore, never transferred a symmetric-keys master key to the symmetric-keys old master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the symmetric-keys master key. The symmetric-keys master key that was current when you changed the master key was placed in the symmetric-keys old master key register.

Old Symmetric-keys Master Key Verification Pattern
If the old master key register is valid, the panel displays a verification pattern for the old master key.

Old Symmetric-Keys Master Key Hash Pattern
If the old master key register is valid, the panel displays a hash pattern for the old master key.

Symmetric-keys Master Key
This field shows the state of the symmetric-keys master key register.

This key register can be in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial symmetric-keys master key, or you have just transferred the contents of this register into the symmetric-keys master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered the symmetric-keys master key on this PCI coprocessor and have chosen either the set or change option.

Symmetric-Keys Master Key Verification Pattern
If the symmetric-keys master key register is valid, the panel displays a verification pattern for the key. When you enter a new master key, *record the verification pattern* that appears on the panel. When the master key becomes active, you can compare the verification patterns to ensure that the one you entered and set is in the symmetric-keys master key register.

If your system is using other PCI Cryptographic Coprocessors and one or more Cryptographic Coprocessor Features, the symmetric-keys master key must be

the same on all the PCI cards, and must also be the same as the DES master key in the Cryptographic Coprocessor Feature. If all these cryptographic coprocessors have valid master key register statuses, the MK verification patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the verification patterns that the PCI Cryptographic Coprocessor calculates appears in SMF record type 82.

Symmetric-Keys Master Key Hash Pattern
If the master key register is valid, the panel displays a hash pattern for the master key.

New Asymmetric-keys Master Key
This field shows the state of the asymmetric-keys new master key register.

This key register can be in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial asymmetric-keys master key, or you have just transferred the contents of this register into the asymmetric-keys master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new asymmetric-keys master key, but have not transferred it to the asymmetric-keys master key register yet. This state appears only when the new asymmetric-keys master key register is loaded from the TKE workstation. The set must be done from the TKE workstation.

New Asymmetric-keys Master Key Hash Pattern
If the asymmetric-keys new master key register is PART FULL, the panel displays a hash pattern for the key. When you use the master key panels to enter a new master key, *record the hash pattern* that appears on the final panel. You can compare the hash pattern you record with this one to ensure that the key entered and the key in the asymmetric-keys new master key register are the same.

Old Asymmetric-keys Master Key
This field shows the states of the asymmetric-keys old master key register.

State	Indication
EMPTY	You have never changed the asymmetric-keys master key and, therefore, never transferred an asymmetric-keys master key to the asymmetric-keys old master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the asymmetric-keys master key. The asymmetric-keys master key that was current when you changed the master key was placed in the asymmetric-keys old master key register.

Old Asymmetric-keys Master Key Hash Pattern
If the old asymmetric-keys master key register is valid, the panel displays a hash pattern for the asymmetric-keys old master key.

Asymmetric-keys Master Key
This field shows the states of the asymmetric-keys master key register.

State	Indication
EMPTY	You have never entered and set an initial asymmetric-keys master key on this PCI coprocessor. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new asymmetric-keys master key on this PCI coprocessor and chosen either the set or change option.

Asymmetric-Keys Master Key Hash Pattern
If the aymmetric-keys master key register is valid, the panel displays a hash pattern for the key. When you enter a new asymmetric-keys master key, *record the hash pattern* that appears on the panel. When the asymmteric-keys master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the asymmetric-keys master key register.

If your system is using other PCI Cryptographic Coprocessors and one or more Cryptographic Coprocessor Features, the asymmetric-keys master key must be the same on all the PCI cards, and must also be the same as both of the PKA master keys in the Cryptographic Coprocessor Feature. If all these cryptographic coprocessors have valid master key register statuses, the MK verification patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the verification patterns that the PCI Cryptographic Coprocessor calculates appears in SMF record type 82.

Displaying ICRF Hardware Status

When you select the Status option on the Installation Options and Status panel, the ICRF Hardware Status Display panel appears. Refer to Figure 262 on page 298.

```
CSFMKP10 ----------- OS/390 ICSF - Hardware Status Display ----------------
COMMAND ===>

                                                          CRYPTO DOMAIN: 0



KSU/REGISTER STATUS           KSU 0                   KSU 1

  Crypto CPs installed      : 0                     : 3
  Crypto CPs active         : 0                     : 3
  Physical switch position  : NORMAL                : NORMAL
  Key Part register         : DISABLED and EMPTY    : DISABLED and EMPTY
  New Master Key register   : EMPTY                 : EMPTY
  NMK verification pattern  :                       :
  Old Master Key register   : VALID                 : VALID
  OMK verification pattern  : EF569412CD91AB78      : EF569412CD91AB78
  Master Key register       : VALID                 : VALID
  MK verification pattern   : 1294ABCD5678EF91      : 1294ABCD5678EF91
  Special Secure Mode       : DISABLED              : DISABLED


Press ENTER to refresh the hardware status display.
Press END   to exit to the previous menu.
```

Figure 262. Hardware Status Display Panel for the ICRF on a Bipolar Processor

On this panel, you can view the status of the ICRF. You can check whether a unit is active, whether its registers are in the correct state, and whether its switches are in the correct positions. To refresh the status, press the ENTER key again.

Some servers allow you to partition the processor unit into two sides (side 0 and side 1). The individual central processors, processor storage arrays, and the channel subsystems are associated with side 0 or side 1. Such a processor is called a *multiprocessor model* and may have up to two KSUs. If it has two, one is attached to each side. The unit on Side 0 is called KSU 0, and the one on Side 1 is called KSU 1.

If two KSUs exist, the panel shows status for both. If only one key storage unit exists, the panel shows just the status for that unit. The fields for the second key storage unit are blank.

The hardware status fields on this panel contain the following information:

CRYPTO DOMAIN
This field displays the value that is specified for the DOMAIN keyword in the installation options data set at ICSF startup. This is the domain in which your system is currently working. It specifies which one of several separate sets of master key registers you can currently access. A system programmer can use the DOMAIN keyword in the installation options data set to specify the domain value to use at ICSF startup. For more information about the DOMAIN installation option, see 282.

KSU/REGISTER STATUS
The KSU/Register Status fields on the panel give you the following information about the KSUs in your processor complex.

The field directly below the KSU number displays the KSU status. The values that can appear in this field are as follows:

Value	Indication
<blank>	The KSU is fully operational.
STANDBY	The KSU mode select key switch is in the **Standby** or **Zeroize** position.
TAMPER DETECTED	A tamper has been detected.
HARDWARE FAILURE	A permanent hardware error has been detected.

Crypto Module ID
This field displays the unique 128-bit value that was generated for this crypto module during the manufacturing process.

Crypto CPs Installed
This field displays the processor numbers of the CPs that have an ICRF installed and are online to MVS.

Crypto CPs Active
This field displays the processor numbers of the CPs that have a ICRF available and that can be used by ICSF.

Physical Switch Position
This field shows the current position of the operator key switch. On bipolar processors with a KSU, this field refers to the position of actual physical switches on the KSU. This field indicates either a normal status or a state of readiness for the entry of a specific key part.

The possible positions of the key switches are:

Switch Position	Indication
Normal	The physical switch is in the Normal position. The switch should be in the Normal position during normal operation unless you are entering master keys or operational keys.
Enter KP1	If the Operator Key Switch is in this position when you are entering operational keys, you can enter the first key part.
Enter KP2	If the Operator Key Switch is in this position when you are entering operational keys, you can enter either an intermediate or final key part.
Enter NMK(1)	If the Operator Key Switch is in this position when you are entering a DES master key, you can enter the first master key part.
Enter NMK(2)	If the Operator Key Switch is in this position when you are entering a DES master key, you can enter either an intermediate or final master key part.

Key Part Register
This field shows the states of the key part register in the KSU.

You can put the key part register in any of the following states:

State	Indication
ENABLED and EMPTY	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position. You are accessing the correct ICSF panel, but have not yet entered the actual key part.
ENABLED and FULL	A key switch is in either the Enter NMK(1) or the Enter NMK(2) position. You are entering a key part into the key part register, but have not completed the panel path to move the key part into the new master register.
DISABLED and EMPTY	You have accessed the complete path of panels to enter a key part. ICSF has transferred the key part to the master key register, and returned the key switch to the Normal position.

New Master Key Register

This field shows the state of the new master key register.

This key register can be in any of the following states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

The new master key is held in an auxiliary key register. This auxiliary key register can contain either a new master key or an old master key. Therefore, a new master key and the old master key cannot coexist.

NMK Verification Pattern

If the new master key register is FULL, the panel displays a verification pattern for the key. When you use the master key panels to enter a new master key, *record the verification pattern* that appears on the final panel. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system has two KSUs, you must enter the same master key into both units. If the units have valid new master key register statuses, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Old/New Master Key register

This field shows the states of the old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

The old/new master key register is actually the auxiliary master key register. The auxiliary master key register can contain either the new master key or the old master key. Therefore a new master key and an old master key cannot coexist at the same time. If an old master key exists, it is lost when you enter a new one. Therefore, you should convert all your keys from under the old master key to under the current master key before you enter a new master key.

OMK Verification Pattern
If the old master key register is valid, the panel displays a verification pattern for the old master key.

Master Key Register
This field shows the states of the master key register.

State	Indication
EMPTY	You have never entered and set an initial master key on this KSU.
VALID	You have entered a new master key on this KSU and chosen either the set or change option.

MK Verification Pattern
If the master key register is valid, the panel displays a verification pattern for the key. When you enter a new master key, *record the verification pattern* that appears on the panel. When the master key becomes active, you can compare the verification patterns to ensure that the one you entered and set is in the master key register.

If your system is using two KSUs, you enter the same master key into both units. If both units have valid master key register statuses, the MK verification patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the verification patterns that the ICRF calculates appears in SMF record type 82.

Special Secure Mode
This field shows if the special secure mode is enabled or disabled. Special secure mode is a lower form of security. This mode allows you to use KGUP to enter clear keys, produce clear PINs, use the secure key import callable service, and initialize the CKDS. On the bipolar processor, special secure mode is enabled when the mode switch on the KSU is in the **Special Secure Mode** position and the SSM installation option is set to YES. On the bipolar processor, special secure mode does not need to be enabled to manually enter a key.

Displaying PCICC Status

The PCICC Management panel displays the status of all PCICC Cryptographic Coprocessors installed. From the main panel, select option 9 - PCICC MGMT. A panel similar to Figure 263 on page 302 appears.

```
CSFMPCIM0 ----------- OS/390 ICSF - PCICC Management     ----------------
                                                        Row 00001 of 00008
COMMAND ===>_____________________________________       Scroll ===> HALF

Coprocessor    Serial Number   Status

_P32           41-K0001        ONLINE
_P35           41-K0003        ACTIVE
_P37                           OFFLINE
_P38           41-3AB22        DISABLED
```

Figure 263. PCICC Management Display Panel

Note that the command line may appear at the bottom of the screen depending on the user's ISPF option.

The following states are valid:

State	Indication
ONLINE	The PCICC is available for certain commands, but either or both of the master keys is incorrect.
OFFLINE	A PCICC may be physically present but it is not available to the operating system. Either it has never been configured online or it has been configured offline by an operator command.
ACTIVE	The PCICC has correct master keys and can be used for all eligible commands.
DEACTIVATED	The PCICC is online and may have correct master keys, but it has been removed from service with this management panel.
DISABLED	A Trusted Key Entry (TKE) workstation has removed the PCICC from service. Only a TKE workstation can enable the PCICC from this state.
UNKNOWN: CODE = cccc/ssss	The PCICC has returned an unrecognizable code in reponse to an attempt to determine its status. The return/reason code appears as the value of CODE.
TEMPORARILY UNAVAILABLE	An unexpected error has been returned from the card. The system goes into recovery to try to reset the card. If the reset is successful, the card is usable again. The user will have to press ENTER to refresh the status.
HARDWARE ERROR	The PCICC has been stopped.

There are three action characters that can be entered on the left of the coprocessor number.

Character	Indication
d	Makes a PCICC unavailable. The PCICC status becomes DEACTIVATED. When the request is made, the status of the PCICC may be anything except OFFLINE.
a	Makes available a PCICC previously deactivated by a d action character. When the request is made, if the PCICC is online and the master keys are correct, the status will be ACTIVE. If the master keys are incorrect, the status will be ONLINE.
s or /	Displays hardware status. See Figure 261 on page 293 as an example.

Displaying Installation Exits

ICSF provides points where you can call your own exit routines. You can write and define installation exits to perform installation specific processing. You specify the exits in the installation options data set that is called at ICSF startup.

ICSF provides the following types of exits:

- ICSF mainline exits
- Key generator utility program exit
- Callable services exits
- Cryptographic Key Data Set (CKDS) Conversion program exit
- Single-record, read-write exit
- CKDS retrieval exit
- Security exits

The mainline exits are called when you start and stop ICSF. The key generator utility program exit is called during key generator utility program processing. The callable services exits are called during each of the callable services. The CKDS conversion program exit is called during conversion of CUSP or PCF CKDS to ICSF CKDS format. The single-record, read-write exit is called when an access to a single record is made to a disk copy of the CKDS. The security exits are called during initialization and stopping of ICSF, during a call to a callable service, and during access of a CKDS entry.

For a detailed description of the ICSF exits, see the *OS/390 ICSF System Programmer's Guide*.

To display installation exits:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 264 on page 304.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility ---------
OPTION ===> 3

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 264. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options and Status panel appears. Refer to Figure 265.

```
CSFSOP00 ----------- OS/390 ICSF - Installation Options and Status --------
OPTION ===> 3

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  STATUS   -  Display Hardware Status
  3  EXITS    -  Display Installation exits and exit options
  4  SERVICES -  Display Installation Defined Services
```

Figure 265. Installation Options and Status Panel

2. Select option 3, Exits, on the Installation Options Status panel.

   The first of the Installation Exits Display panels appears. Refer to Figure 266.

```
CSFSOP30 ------ OS/390 ICSF - Installation Exits Display ---- ROW 1 TO 18 OF 70
COMMAND ===>

ICSF NAME      LOAD MODULE      OPTIONS
-------------  -----------      -------
 CSFAEGN                        *** No Exit Name was specified ***
 CSFAKEX                        *** No Exit Name was specified ***
 CSFAKIM                        *** No Exit Name was specified ***
 CSFAKTR                        *** No Exit Name was specified ***
 CSFATKN                        *** No Exit Name was specified ***
 CSFCKDS                        *** No Exit Name was specified ***
 CSFCKI                         *** No Exit Name was specified ***
 CSFCKM                         *** No Exit Name was specified ***
 CSFCONVX                       *** No Exit Name was specified ***
 CSFCPA                         *** No Exit Name was specified ***
 CSFCSG                         *** No Exit Name was specified ***
 CSFCSV                         *** No Exit Name was specified ***
 CSFCTT                         *** No Exit Name was specified ***
 CSFCTT1                        *** No Exit Name was specified ***
 CSFDCO                         *** No Exit Name was specified ***
 CSFDEC                         *** No Exit Name was specified ***
 CSFDEC1                        *** No Exit Name was specified ***
 CSFDKX                         *** No Exit Name was specified ***
 CSFDSG                         *** No Exit Name was specified ***
 CSFDSV                         *** No Exit Name was specified ***
 CSFDVPI                        *** No Exit Name was specified ***
 CSFECO                         *** No Exit Name was specified ***
 CSFEDC         USEREDC         NONE - Take no action, if this exit fails
```

Figure 266. First Installation Exits Display Panel

The Installation Exits Display panel displays the ICSF name for all the possible installation exits your installation can write.

3. Scroll through the screens, to view all of the installation exits.

   The second panel of exits is shown in Figure 267.

```
CSFSOP30 ------ OS/390 ICSF - Installation Exits Display --- ROW 19 TO 36 OF 70
COMMAND ===>

ICSF NAME      LOAD MODULE      OPTIONS
-------------  -----------      -------
 CSFEMK                         *** No Exit Name was specified ***
 CSFENC                         *** No Exit Name was specified ***
 CSFENC1                        *** No Exit Name was specified ***
 CSFESECI                       *** No Exit Name was specified ***
 CSFESECK                       *** No Exit Name was specified ***
 CSFESECS                       *** No Exit Name was specified ***
 CSFESECT                       *** No Exit Name was specified ***
 CSFEXIT2                       *** No Exit Name was specified ***
 CSFEXIT3                       *** No Exit Name was specified ***
 CSFEXIT4                       *** No Exit Name was specified ***
 CSFEXIT5                       *** No Exit Name was specified ***
 CSFGKC                         *** No Exit Name was specified ***
 CSFKEX                         *** No Exit Name was specified ***
 CSFKGN                         *** No Exit Name was specified ***
 CSFKGUP                        *** No Exit Name was specified ***
 CSFKIM                         *** No Exit Name was specified ***
 CSFKPI                         *** No Exit Name was specified ***
 CSFKRC                         *** No Exit Name was specified ***
 CSFKRD                         *** No Exit Name was specified ***
 CSFKRR                         *** No Exit Name was specified ***
 CSFKRW                         *** No Exit Name was specified ***
 CSFKYT                         *** No Exit Name was specified ***
 CSFKYTX                        *** No Exit Name was specified ***
 CSFMDG                         *** No Exit Name was specified ***
```

Figure 267. Second Installation Exits Display Panel

The third panel of exits is shown in Figure 268 on page 306.

```
CSFSOP30 ----- OS/390 ICSF - Installation Exits Display ---- ROW 37 TO 54 OF 70
COMMAND ===>

ICSF NAME  LOAD MODULE   OPTIONS
------------  -----------   -------
 CSFMDG1                     *** No Exit Name was specified ***
 CSFMGN                      *** No Exit Name was specified ***
 CSFMGN1                     *** No Exit Name was specified ***
 CSFMVR                      *** No Exit Name was specified ***
 CSFMVR1                     *** No Exit Name was specified ***
 CSFOWH                      *** No Exit Name was specified ***
 CSFOWH1                     *** No Exit Name was specified ***
 CSFPCI                      *** No Exit Name was specified ***
 CSFPEXX                     *** No Exit Name was specified ***
 CSFPGN                      *** No Exit Name was specified ***
 CSFPKD                      *** No Exit Name was specified ***
 CSFPKE                      *** No Exit Name was specified ***
 CSFPKG                      *** No Exit Name was specified ***
 CSFPKI                      *** No Exit Name was specified ***
 CSFPKRC                     *** No Exit Name was specified ***
 CSFPKRD                     *** No Exit Name was specified ***
 CSFPKRR                     *** No Exit Name was specified ***
 CSFPKRW                     *** No Exit Name was specified ***
 CSFPKSC                     *** No Exit Name was specified ***
 CSFPTR                      *** No Exit Name was specified ***
 CSFPVR                      *** No Exit Name was specified ***
 CSFRKD                      *** No Exit Name was specified ***
 CSFRKL                      *** No Exit Name was specified ***
 CSFRNG        EXITRNG       EXIT - Do not call this exit again, if it fails
 CSFRTC                      *** No Exit Name was specified ***
 CSFSBC                      *** No Exit Name was specified ***
 CSFSBD                      *** No Exit Name was specified ***
```

Figure 268. Third Installation Exits Display Panel

The fourth panel of exits is shown in Figure 269.

```
CSFSOP30 ----- OS/390 ICSF - Installation Exits Display ---- ROW 55 TO 70 OF 70
COMMAND ===>

ICSF NAME      LOAD MODULE   OPTIONS
------------  -----------   -------
 CSFSKI                      *** No Exit Name was specified ***
 CSFSKM                      *** No Exit Name was specified ***
 CSFSRRW                     *** No Exit Name was specified ***
 CSFSYG                      *** No Exit Name was specified ***
 CSFSYI                      *** No Exit Name was specified ***
 CSFSYX                      *** No Exit Name was specified ***
 CSFTCK                      *** No Exit Name was specified ***
 CSFUDK                      *** No Exit Name was specified ***
**************************BOTTOM OF DATA***************************************
```

Figure 269. Fourth Installation Exits Display Panel

The system programmer specified the exit identifier, the load-module-name, and the failure option for each exit your installation uses with the EXIT keyword in the installation options data set. On this panel, you can view information

about any exit that is specified in the installation options data set. The exit identifier is the ICSF name for the exit.

Figure 270 shows the names for some general ICSF exits. Figure 271 and Figure 272 on page 309 show the ICSF name for each callable service exit.

Figure 270. General ICSF Exits and Exit Identifiers

General ICSF Exit	Exit Identifier
Conversion Exit	**CSFCONVX**
Cryptographic Key Data Set Retrieval Exit	**CSFCKDS**
Key Generator Utility Program Exit	**CSFKGUP**
Mainline Exits	**CSFEXIT2, CSFEXIT3, CSFEXIT4, CSFEXIT5**
Security Initialization Exit Point	**CSFESECI**
Security Key Exit Point	**CSFESECK**
Security Service Exit Point	**CSFESECS**
Security Termination Exit Point	**CSFESECT**
Single-record, Read-write Exit Point	**CSFSRRW**

Figure 271 (Page 1 of 3). Callable Service and its Exit Identifier

Service	Exit Identifier
ANSI X9.17 EDC generate	**CSFAEGN**
ANSI X9.17 Key Export	**CSFAKEX**
ANSI X9.17 Key Import	**CSFAKIM**
ANSI X9.17 Key Translate	**CSFAKTR**
ANSI X9.17 Transport Key Partial Notarize	**CSFATKN**
Clear PIN Generate Alternate	**CSFCPA**
Clear Key Import	**CSFCKI**
Cipher Text Translate	**CSFCTT**
Cipher Text Translate (with ALET)	**CSFCTT1**
Decode	**CSFDCO**
Decipher	**CSFDEC**
Decipher (with ALET)	**CSFDEC1**
Data Key Export	**CSFDKX**
Digital Signature Generate	**CSFDSG**
Digital Signature Verify	**CSFDSV**
Encode	**CSFECO**
Cipher/Decipher	**CSFEDC**
Encipher under Master Key	**CSFEMK**
Encipher	**CSFENC**
Encipher (with ALET)	**CSFENC1**
Key Export	**CSFKEX**
Key Generate	**CSFKGN**

Figure 271 (Page 2 of 3). Callable Service and its Exit Identifier

Service	Exit Identifier
Key Import	**CSFKIM**
Key Part Import	**CSFKPI**
Key Record Create	**CSFKRC**
Key Record Delete	**CSFKRD**
Key Record Read	**CSFKRR**
Key Record Write	**CSFKRW**
Key Test	**CSFKYT**
Key Test Extended	**CSFKYTX**
MAC Generate	**CSFMGN**
MAC Generate (with ALET)	**CSFMGN1**
MAC Verify	**CSFMVR**
MAC Verify (with ALET)	**CSFMVR1**
MDC Generate	**CSFMDG**
MDC Generate (with ALET)	**CSFMDG1**
Multiple Clear Key Import	**CSFCKM**
Multiple Secure Key Import	**CSFSCKM**
One-Way Hash Generate	**CSFOWH**
One-Way Hash Generate (with ALET)	**CSFOWH1**
PCI Interface	**CSFPCI**
PIN Generate	**CSFPGN**
PIN Translate	**CSFPTR**
PIN Verify	**CSFPVR**
PKA Decrypt	**CSFPKD**
PKA Encrypt	**CSFPKE**
PKA Key Generate	**CSFPKG**
PKA Key Import	**CSFPKI**
PKDS Record Create	**CSFPKRC**
PKDS Record Delete	**CSFPKRD**
PKDS Record Read	**CSFPKRR**
PKDS Record Write	**CSFPKRW**
Prohibit Export Extended	**CSFPEXX**
Random Number Generate	**CSFRNG**
Retained Key Delete	**CSFRKD**
Retained Key List	**CSFRKL**
Secure Key Import	**CSFSKI**
SET Block Compose	**CSFSBC**
SET Block Decompose	**CSFSBD**
Symmetric Key Generate	**CSFSYG**

Figure 271 (Page 3 of 3). Callable Service and its Exit Identifier	
Service	**Exit Identifier**
Symmetric Key Import	**CSFSYI**
Symmetric Key Export	**CSFSYX**
Transform CDMF Key	**CSFTCK**
User Derived Key	**CSFUDK**
VISA CVV Service Generate	**CSFCSG**
VISA VISA CVV Service Verify	**CSFCSV**

Figure 272. Compatibility and its Exit Identifier	
Service	**Exit Identifier**
Encipher under Master Key	**CSFEMK**
CUSP/PCF GENKEY Service	**CSFGKC**
CUSP/PCF RETKEY Service	**CSFRTC**
Cipher/Decipher	**CSFEDC**

The load module name is the name of the module that contains the exit. The LOAD MODULE column on the panel lists the load module name for each exit. The OPTIONS column on this panel lists the action to occur if the exit fails.

4. To change the module name or failure option of an exit or add a new exit after viewing this panel, access the installation options data set. In the data set, change how you specified an exit or specify a new exit and restart ICSF.

Displaying Installation-Defined Callable Services

Your installation can write its own service similar to an ICSF callable service. Before you can run an installation-defined service, you must do the following:

- Write the service.
- Define the service.
- Write a service stub and link it with your application program.

For more information about writing, defining, and running an installation-defined service, see the *OS/390 ICSF System Programmer's Guide*.

To display information about installation-defined callable services:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 273 on page 310.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility ---------
OPTION ===> 3

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
```

Figure 273. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options and Status panel appears. Refer to Figure 274.

```
CSFSOP00 ----------- OS/390 ICSF - Installation Options and Status --------
OPTION ===> 4

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  STATUS   -  Display Hardware Status
  3  EXITS    -  Display Installation exits and exit options
  4  SERVICES -  Display Installation Defined Services
```

Figure 274. Installation Options and Status Panel

2. Select option 4, Services, on the Installation Options Status panel.

   The Installation Defined Services panel appears. Refer to Figure 275.

```
CSFSOP40 -------- OS/390 ICSF - Installation Defined Services --- ROW 1 TO 8 OF 8
COMMAND ===>

  SERVICE NUMBER        INSTALLATION NAME
  --------------        -----------------

         1               SERVICE1
         3               SERVICE3
         5               SERVICE5
         6               SERVICE6
         8               SERVICE8
        11               SERVICEB
        13               SERVICED
****************************BOTTOM OF DATA************************************
```

Figure 275. Installation-Defined Services Display Panel

The system programmer used the SERVICE keyword in the installation options data set to specify the service-number, the load-module-name, and fail-option for each service. The service number identies the service to ICSF. The load-module-name identifies the module that contains the installation-defined service. The Installation Name column on the panel lists the load-module-name for each installation service.

The panel displays the service number and the corresponding installation name for each installation-defined service that is specified in the installation options data set.

Note: If your installation does not have any installation-defined callable services and you select option 4, the message NO GENERIC

SERVICES displays and you remain on the Installation Options and Status panel.

At ICSF start up, you define an installation options data set that contains the options your installation wants to use. The options specify certain modes and conditions on your ICSF system. You specify the keyword and value for each option in the installation options data set. You specify the data set name in the startup procedure. When you start ICSF, the options become active.

Chapter 10. Using the Utility Panels to Encode and Decode Data

Encoding data is enciphering data by using a clear key. Decoding data is deciphering data by using the same clear key that enciphered the data. You can use the utility panels to encode and decode data.

Note: ICSF must be active with a valid master key before the encode and decode options may be used. Encode and decode are available only on a DES-capable server or processor. CDMF-only systems cannot use encode and decode.

Encoding Data

To encode data:

1. Select option 5, UTILITIES, on the Primary Option panel, and press ENTER. Refer to Figure 276.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  MASTER KEY    -  Set or change the system master key
  2  KGUP          -  Key Generator Utility processes
  3  OPSTAT        -  Installation options and Hardware status
  4  OPKEY         -  Operational key direct input
  5  UTILITY       -  OS/390 ICSF Utilities
```

Figure 276. Selecting the Utilities Option on the Primary Menu Panel

The Utilities panel appears. See Figure 277.

```
CSFUTL00 -------------- OS/390 ICSF - Utilities ---------------------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification pattern
```

Figure 277. Selecting the Encode Option on the Utilities Panel

2. Select option 1, Encode, on this panel.

   The Encode panel appears. See Figure 278 on page 314.

```
CSFECO00 -------------- OS/390 ICSF - Encode -----------------------------
COMMAND ===>


Enter data below:

  Clear Key       ===>  0000000000000000   Clear Key Value
  Plaintext       ===>  0000000000000000   Data to be encoded
  Ciphertext         :  0000000000000000   Output from the encode
```

Figure 278. Encode Panel

3. In the Clear Key field, enter the clear value of the key you want ICSF to use to encode the data.
4. In the Plaintext field, enter the data in hexadecimal form that you want ICSF to encode.
5. Press ENTER.

   ICSF uses the clear key and the DES algorithm to encode the data. The encoded data is displayed in the Ciphertext field.
6. Press END to return to the Utilities panel.
7. Press END to return to the Primary Option panel.

Decoding Data

To decode data:

1. Select option 5, UTILITY, on the Primary Option panel and press ENTER.

   The Utilities panel appears. See Figure 279.

```
CSFUTL00 -------------- OS/390 ICSF - Utilities --------------------------
OPTION ===> 2


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification pattern
```

Figure 279. Selecting the Encode Option on the Utilities Panel

2. Select option 2, Decode, on this panel.

   The Decode panel appears. See Figure 280 on page 315.

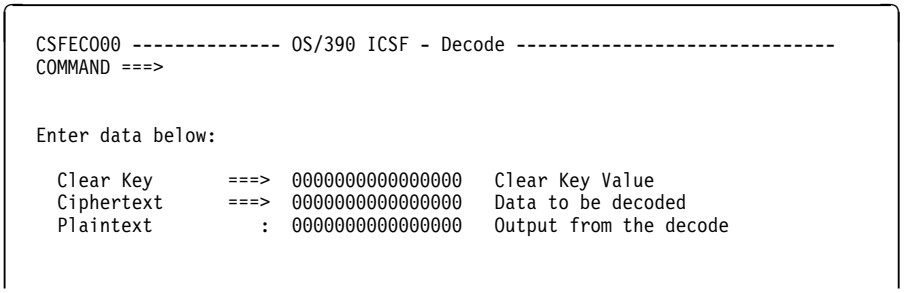

Figure 280. Decode Panel

3. In the Clear Key field, enter the clear value of the key you want ICSF to use to decode the data. This needs to be the same key value that was used to encode the data.
4. In the Ciphertext field, enter the data in hexadecimal form that you want ICSF to decode.
5. Press ENTER.

   ICSF uses the clear key and the DES algorithm to decode the data. The decoded data is displayed in the Plaintext field.
6. Press END to return to the Utilities panel.
7. Press END to return to the Primary Option panel.

Chapter 11. Using the ICSF Utility Program CSFEUTIL

This chapter contains Programming Interface Information.

ICSF provides a utility program, CSFEUTIL, that performs certain functions that can also be performed using the administrator's panels. The utility can be used for installations with the cryptographic coprocessor feature and the PCI cryptographic coprocessor feature. You can run the utility program to perform the following tasks:

- Reencipher a disk copy of a CKDS
- Change the master key
- Refresh the in-storage CKDS

You invoke the program as a batch job or from another program. To invoke the program as a batch job, use JCL. You specify different parameters on the EXEC statement depending on the task you want the utility program to perform. To invoke the program from another program, use standard MVS linkages like LINK, ATTACH, LOAD, and CALL.

For information about using the utility program to reencipher a disk copy of a CKDS and change the master key, see "Reenciphering a Disk Copy of a CKDS and Changing the Master Key." For information about using the program to refresh the in-storage CKDS, see "Refreshing the In-Storage CKDS Using a Utility Program" on page 318.

Reenciphering a Disk Copy of a CKDS and Changing the Master Key

This section describes how to use the utility program to reencipher a disk copy of a CKDS and to change a master key.

Note: Before performing any function that affects the current CKDS, such as reenciphering, refreshing, or changing the master key, consider temporarily disallowing dynamic CKDS update services. For more information, refer to "Disallowing Dynamic CKDS Updates During KGUP Updates" on page 214.

1. Before you change a master key, you must first reencipher any disk copies of the CKDSs under the new master key in the new master key register.

   You can reencipher a CKDS either using the panels or the utility program.

   Note: In compatibility or co-existence mode, you can use the utility program to reencipher a CKDS but not to change the master key. To change the master key using the utility program, you must be in noncompatibility mode.

2. Invoke the program as a batch job or from another program.

   You pass the same parameters whether you call the program as a batch job or from another program.

3. Pass the names of the CKDSs upon which to perform the task and the name of the task to perform.

   When you invoke the utility program from another program, General Register 1 must contain the address of a data area whose structure is as follows:

```
Bytes 0-1: Length of the parameter string in binary
Bytes 2-n: The parameter string
```

The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.

4. To reencipher a disk copy of a CKDS, pass the following parameters in the following order:
   a. The name of the disk copy of the CKDS to reencipher.
   b. The name of an empty disk copy of the CKDS to contain the reenciphered keys.
   c. The name for the task: REENC.
5. To reencipher the CKDS using JCL, use JCL like the following example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='OLD.CKDS,NEW.CKDS,REENC'
   ```

   The first parameter passed, OLD.CKDS, is the name of the disk copy to reencipher. The second parameter, NEW.CKDS, is the name of an empty disk copy of the CKDS where you want ICSF to place the reenciphered keys.
6. After you reencipher all the disk copies of the CKDSs under the new master key, make the new master key active by changing the master key.

   The utility program activates the new master key and reads a disk copy of a CKDS reenciphered under the new master key into storage.
7. To change a master key, pass the following parameters in the following order:
   a. The name of the disk copy of the CKDS to read into storage.
   b. The name for the task: CHANGE.
8. To change the master key using JCL, use JCL like the following example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='NEW.CKDS,CHANGE'
   ```

   The utility program reads the new master key into the master key register to make that master key active. The program also reads into storage a disk copy of the CKDS that you specify. This CKDS should be reenciphered under the new master key that you are making the current master key. The first parameter passed, NEW.CKDS, is the name of the disk copy of the CKDS that you want ICSF to read into storage.

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The return codes and reason codes are explained in “Return and Reason Codes for the CSFEUTIL Program” on page 319.

Refreshing the In-Storage CKDS Using a Utility Program

This section describes how to use the CSFEUTIL program to refresh an in-storage CKDS.

1. Invoke the program from a batch job or from another program.
2. You pass the same parameters whether you call the program as a batch job or from another program.

3. Pass the names of the CKDSs to perform the task and the name for the task. When you invoke the utility program from another program, General Register 1 must contain the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.

4. To refresh an in-storage CKDS, pass the following parameters in the following order:
   - The name of the disk copy of the CKDS that you want read into storage
   - The name for the task: REFRESH

5. To refresh the CKDS using JCL, use JCL like the following example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='NEW.CKDS,REFRESH'
   ```

   The first parameter passed, NEW.CKDS, is the name of the disk copy of the CKDS that you want read into storage.

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The return codes and reason codes are explained in "Return and Reason Codes for the CSFEUTIL Program."

Return and Reason Codes for the CSFEUTIL Program

When you invoke the CSFEUTIL program as a batch job, you receive the return code in a message when the job completes. The meanings of the return codes are as following:

Return Code	Meaning
0	Process successful.
8	RACF authorization check failed.
12	Change master key process unsuccessful.
72 or 104	Refresh or Reencipher process unsuccessful.

When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The meaning of the reason codes are as follows:

For return code 8:

Reason Code	Meaning
16000	Invoker has insufficient RACF access authority to perform function.

For return code 12:

Reason Code Meaning

16000 Invoker has insufficient access authority to perform function (also applicable to refresh and reencipher).

36000 Unable to change master key. Check hardware status.

36020 Input CKDS is empty or not initialized (authentication pattern in the control record is invalid).

36036 The new master key register for Key Storage Unit 1 (KSU 1) is not full, but KSU 0 is ready and the current master key is valid.

36040 The new master key register for KSU 0 is not full, but KSU 1 is ready and the current master key is valid.

36044 The master key authentication pattern for the CKDS does not match the authentication pattern of the KSUs, which are not equal.

36048 The master key authentication pattern for the CKDS does not match the authentication pattern of either of the KSUs, which are not equal.

36052 A valid new master key is present in KSU 0, but its authentication pattern does not match that of KSU 1 or the CKDS, which are equal.

36056 A valid new master key is present in KSU 1, but its authentication pattern does not match that of KSU 0 or the CKDS, which are equal.

36060 The new master key register(s) is/are not full.

36064 Both new master key registers are full but not equal.

36068 The input CKDS is not enciphered under the current master key.

36076 The new master key register for KSU 0 is not full, but the CPUs are online.

36080 The new master key register for KSU 1 is not full, but the CPUs are online.

36084 The master key register cannot be changed since ICSF is running in compatibility mode.

For return code 72 or 104:

Reason Code Meaning

6008 A service routine has failed.

The service routines that may be called are:

CSFMGN	MAC generation
CSFMVR	MAC verification
CSFMKVR	Master key verification

6012 The single-record, read-write installation exit (CSFSRRW) returned a return code greater than 4.

6016 An I/O error occurred reading or writing the CKDS.

6020 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that the invoking service should end.

6024 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that ICSF should end.

6028 The CKDS access routine could not establish the ESTAE environment.

6040 The CSFSRRW installation exit could not be loaded and is required.

6044 Information necessary to set up CSFSRRW installation exit processing could not be obtained.

6048 The system keys cannot be found while attempting to write a complete CKDS data set.

6052 For a write CKDS record request, the current master key verification pattern (MKVP) does not match the CKDS header record MKVP.

Note: It is possible that you will receive MVS reason codes rather than ICSF reason codes, for example, if the reason code indicates a dynamic allocation failure. For an explanation of MVS reason codes, see *OS/390 MVS System Codes*.

Appendix A. Control Vector Table

Note: The Control Vectors used in ICSF are exactly the same as documented in CCA and the TSS manuals.

The master key enciphers all keys operational on your system. A transport key enciphers keys that are distributed off your system. Before a master key or transport key enciphers a key, ICSF exclusive ORs both halves of the master key or transport key with a control vector. The same control vector is exclusive ORed to the left and right half of a master key or transport key.

Also, if you are entering a key part, ICSF exclusive ORs each half of the key part with a control vector before placing the key part into the CKDS.

Each type of key on ICSF (except the master key) has either one or two unique control vectors associated with it. The control vector that ICSF exclusive ORs the master key or transport key with depends on the type of key the master key or transport key is enciphering. For double-length keys, a unique control vector exists for each half of a specific key type. For example, there is a control vector for the left half of an input PIN-encrypting key, and a control vector for the right half of an input PIN-encrypting key.

If you are entering a key part into the CKDS, ICSF exclusive ORs the key part with the unique control vector(s) associated with the key type. ICSF also enciphers the key part with two master key variants for a key part. One master key variant enciphers the left half of the key part, and another master key variant enciphers the right half of the key part. ICSF creates the master key variants for a key part by exclusive ORing the master key with the control vectors for key parts. These procedures protect key separation.

Figure 281 displays the value of the control vector that is associated with each type of key. For keys that are double-length, ICSF enciphers a unique control vector on each half.

Figure 281. Control Vector Table

Key Type	Control Vector Value (Hex)
ANSI key-encrypting key	00 00 00 00 00 00 00 00
Data-encrypting key	00 00 00 00 00 00 00 00
DATAM key (left and right half) - internal	00 05 4D 00 03 00 00 00
DATAM generation key (left half) - external	00 00 4D 00 03 41 00 00
DATAM generation key (right half) - external	00 00 4D 00 03 21 00 00
DATAMV MAC verification key (left and right half) - internal	00 05 44 00 03 00 00 00
DATAMV MAC verification key (left half) - external	00 00 44 00 03 41 00 00
DATAMV MAC verification key (right half) - external	00 00 44 00 03 21 00 00
Data-translation key	00 06 71 00 03 00 00 00
MAC generation key	00 05 4D 00 03 00 00 00
MAC verification key	00 05 44 00 03 00 00 00
Input PIN-encrypting key (left half)	00 21 5F 00 03 41 00 00
Output PIN-encrypting key (left half)	00 24 77 00 03 41 00 00
Input PIN-encrypting key (right half)	00 21 5F 00 03 21 00 00
Output PIN-encrypting key (right half)	00 24 77 00 03 21 00 00
PIN generation key (left half)	00 22 7E 00 03 41 00 00
PIN verification key (left half)	00 22 42 00 03 41 00 00
PIN generation key (right half)	00 22 7E 00 03 21 00 00
PIN verification key (right half)	00 22 42 00 03 21 00 00
Export key-encrypting key (left half)	00 41 7D 00 03 41 00 00
Import key-encrypting key (left half)	00 42 7D 00 03 41 00 00
Export key-encrypting key (right half)	00 41 7D 00 03 21 00 00
Import key-encrypting key (right half)	00 42 7D 00 03 21 00 00
Key part (left half)	00 FF 41 00 03 48 00 00
Key part (right half)	00 FF 41 00 03 28 00 00
Intermediate MAC	00 11 41 00 03 00 00 00
Compatibility importer	22 22 22 22 22 22 22 22
Compatibility exporter	88 88 88 88 88 88 88 88
PKA importer key (left half)	00 42 05 00 03 41 00 00
PKA importer key (right half)	00 42 05 00 03 21 00 00

Note: The external control vectors for DATAM MAC generation and DATAMV MAC verification keys are also referred to as data compatibility control vectors.

Appendix B. Supporting Algorithms and Calculations

This appendix shows various algorithms and calculations that are used in cryptographic systems.

Checksum Algorithm

To enter a key or a master key manually, you enter key parts. When you enter a key part, you enter two key part halves and a checksum for the key part. The checksum is a two-digit number you calculate using the key part and the checksum algorithm.

After you enter the key part and the checksum, ICSF calculates the checksum for the key part you entered. If the checksum you enter and the checksum ICSF calculates do not match, you did not enter the key part correctly and should reenter it. Before you enter a key part, you need to calculate the checksum. You can use the ICSF utility panels that are described in “Generating Key Part Data for Manual Key Entry” on page 145 or the checksum algorithm that is described in this appendix.

In the checksum algorithm, you use the following operations:

- Sum Operation

  The addition table in Figure 282 on page 326 defines the sum operation. The sum of two hexadecimal digits i and j is the entry at the intersection of the column i and the row j. For example, the sum of A and 6 is C.

Sum	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	0	3	2	5	4	7	6	9	8	B	A	D	C	F	E
2	2	3	0	1	6	7	4	5	A	B	8	9	E	F	C	D
3	3	2	1	0	7	6	5	4	B	A	9	8	F	E	D	C
4	4	5	6	7	0	1	2	3	C	D	E	F	8	9	A	B
5	5	4	7	6	1	0	3	2	D	C	F	E	9	8	B	A
6	6	7	4	5	2	3	0	1	E	F	C	D	A	B	8	9
7	7	6	5	4	3	2	1	0	F	E	D	C	B	A	9	8
8	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7
9	9	8	B	A	D	C	F	E	1	0	3	2	5	4	7	6
A	A	B	8	9	E	F	C	D	2	3	0	1	6	7	4	5
B	B	A	9	8	F	E	D	C	3	2	1	0	7	6	5	4
C	C	D	E	F	8	9	A	B	4	5	6	7	0	1	2	3
D	D	C	F	E	9	8	B	A	5	4	7	6	1	0	3	2
E	E	F	C	D	A	B	8	9	6	7	4	5	2	3	0	1
F	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

Figure 282. Addition Table

- Shift Operation

  The shift table in Figure 283 defines the shift operation. The shift of digit i is denoted by H(i). For example, the shift of 5 is H(5) = E.

i	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
H(i)	0	C	1	D	2	E	3	F	4	8	5	9	6	A	7	B

Figure 283. Shift Table

In the following description of the algorithm, the two hexadecimal digits of the checksum are represented by P1 and P2 for the set of 32 hexadecimal digits D(1,2,.....,32). The letter i represents the increment.

To calculate the checksum, use the following algorithm:

1. Set i = 0, and set P1 and P2 = 0 (hexadecimal).
2. Let P1 = Sum of P1 and D(i + 1). Let P2 = Sum of P2 and D(i + 2).
3. Let P1 = H(P1). Let P2 = H(P2).
4. Let i = i + 2. If i < 32, go to step 2; otherwise, go to step 5.
5. P1 equals the first checksum digit. P2 equals the second checksum digit.

Algorithm for Calculating a Verification Pattern

To enter a master key or operational key manually, you enter key parts. After you enter a key part, ICSF displays a verification pattern for that key part on a panel. To verify that you entered the key part correctly, you can use the value of the key part you enter to calculate the verification pattern. Check that the verification pattern you calculate matches the verification ICSF calculates.

To calculate this verification pattern, use the following algorithm:

1. If the key part is an operational key part, exclusive OR the key part with the control vector for the key part's key type. See Appendix A, Control Vector Table, for a listing of control vectors by key type. If the key part is a master key part, do not exclusive OR it with a control vector.
2. Use the DES algorithm to encrypt the left half of the key part (either master key part or modified operational key part) under the key `4545 4545 4545 4545`.
3. Exclusive OR the result of step 2 with the left half of the key part.
4. Use the result of step 3 as the DES key in the DES algorithm to encrypt the right half of the key part.
5. Exclusive OR the result of step 4 with the right half of the key part.

The resulting 64-bit value is the verification pattern.

The verification pattern for the master key appears on the KSU Selection and Hardware Status panels. If a master key register is full, the panels display the master key verification pattern. The verification patterns for two identical master keys are the same. You can use the verification patterns to verify that master keys in two different key storage units are the same.

ICSF records a master key verification pattern in the SMF record when you enter a master key part or activate a master key. The ICSF SMF record also records a verification pattern when you enter an operational key part.

Algorithm for Calculating an Authentication Pattern

When you initialize a CKDS, ICSF uses the current master key and the authentication pattern algorithm to calculate an authentication pattern for the CKDS. ICSF places the value of the authentication pattern in the header record of the CKDS.

At ICSF startup, ICSF uses the authentication pattern to verify that the master key enciphers the current CKDS specified at ICSF startup. It compares the authentication pattern that is stored in the CKDS with the authentication pattern it calculates for the master key. If the authentication patterns do not match, ICSF startup fails, and ICSF gives you a message that states that the master key is not valid.

To calculate the authentication pattern, ICSF uses the following algorithm:

1. Encrypt the left half of the master key under the key `6767 6767 6767 6767`, using the DES algorithm.
2. Exclusive OR the result of step 1 with the original left half of the key.

3. Use the result of step 2 as the DES key in the DES algorithm to encrypt the right half of the master key.
4. Exclusive OR the result of step 3 with the original right half of the master key.

The resulting 64-bit value is the authentication pattern.

Pass Phrase Initialization Master Key Calculations

The values for the DES and PKA master keys are calculated in the following manner:

1. ICSF appends a two-byte constant, X'AB45', to the pass phrase, and generates the MD5 hash for the string by using an initial hash value of X'23A0BE487D9BD32003424FAAA34BCE00'. The first eight bytes of the result of this calculation become the last eight bytes of the PKA signature master key and the last eight bytes of the calculation become the last eight bytes of the PKA key management master key.
2. ICSF generates the DES master key value by appending a four-byte constant, X'551B1B1B', to the pass phrase, and generating the MD5 hash for the string using the hash that results from Step 1 as the initial hash value.
3. ICSF appends a three-byte constant, X'2A2A88', to the pass phrase and generates the MD5 hash for the string using the output hash of Step 2 as the initial hash value. The result of this calculation becomes the first 16 bytes of PKA signature master key.
4. ICSF appends a one-byte constant, X'94' to the pass phrase, and generates the MD5 hash for the string using the output hash of Step 3 as the initial hash value. The result of this calculation becomes the first 16 bytes of the PKA key management master key.

Note: If the SMK=KMMK option is selected or defaulted, the KMMK is not used.

The MDC–4 Algorithm for Generating Hash Patterns

The MDC-4 algorithm calculation is a one-way cryptographic function that is used to compute the hash pattern of a key part. MDC uses encryption only, and the default key is 5252 5252 5252 5252 2525 2525 2525 2525.

Notations Used in Calculations

The MDC calculations use the following notation:

eK(X) Denotes DES encryption of plaintext X using key K

|| Denotes the concatenation operation

XOR Denotes the exclusive-OR operation

:= Denotes the assignment operation

T8<1> Denotes the first 8–byte block of text

T8<2> Denotes the second 8–byte block of text, and so on

KD1, KD2, IN1, IN2, OUT1, OUT2 Denote 64–bit quantities

MDC-1 Calculation

The MDC-1 calculation, which is used in the MDC-4 calculation, consists of the following procedure:

```
MDC-1 (KD1, KD2, IN1, IN2, OUT1, OUT2);
   Set KD1mod := set bit 1 and bit 2 of KD1 to "1" and "0", respectively.
   Set KD2mod := set bit 1 and bit 2 of KD2 to "0" and "1", respectively.
   Set F1 := IN1 XOR eKD1mod(IN1)
   Set F2 := IN2 XOR eKD2mod(IN2)
   Set OUT1 := (bits 0..31 of F1) ‖ (bits 32..63 of F2)
   Set OUT2 := (bits 0..31 of F2) ‖ (bits 32..63 of F1)
End procedure
```

MDC-4 Calculation

The MDC-4 calculation consists of the following procedure:

```
MDC-4 (n, text, KEY1, KEY2, MDC);
   For i := 1, 2,...n do
      Call MDC-1(KEY1,KEY2,T8<i>,T8<i>,OUT1,OUT2)
      Set KEY1int := OUT1
      Set KEY2int := OUT2
      Call MDC-1(KEY1int,KEY2int,KEY2,KEY1,OUT1,OUT2)
      Set KEY1 := OUT1
      Set KEY2 := OUT2
   End do
   Set output MDC := (KEY1 ‖ KEY2)
End procedure
```

Appendix C. PR/SM Considerations during Key Entry

If you use logical partition (LPAR) mode provided by the Processor Resource/System Manager (PR/SM), you may have additional considerations when performing the following tasks:

- Entering keys
- Displaying hardware status
- Using the public key algorithm
- Using a TKE Workstation

These additional considerations depend on your processor hardware. For example, LPAR mode permits you to have multiple logical partitions. On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, each logical partition (LP) can have access to the crypto CP, or KSU, for key entry. Therefore, at any given time, multiple LPs can perform key entry procedures. On a bipolar processor, however, only one LP can access the KSU during key entry. Therefore, at any given time, you can enter key parts from only one bipolar LP.

This appendix gives some basic information on using ICSF in LPAR mode. For more detailed information on configuring and running in LPAR mode on the S/390 G3 Enterprise Server, or higher or S/390 Multiprise, refer to the *S/390 PR/SM Planning Guide* and the *S/390 Hardware Management Console Operations*. For more detailed information on configuring and running in LPAR mode on the bipolar processors, refer to the *IBM ES/9000 and ES/3090 Processor Complex PR/SM Planning Guide*.

Allocating Cryptographic Resources to a Logical Partition

LPs operate independently but can share access to the same cryptographic coprocessor, just as they can share access to I/O devices and any other central processor resources. When you activate the LP, you can specify which cryptographic functions are enabled for that LP. The cryptographic resources available to the LP and the way you allocate them to the LP depends on the server or processor your are using.

Allocating Resources on S/390 Enterprise Servers and S/390 Multiprise

On S/390 G3 and G4 Enterprise Servers and S/390 Multiprise you use the Hardware Master Console tasks to enable various cryptographic functions for an LP. To assign a control domain index and usage domain index and initially enable cryptographic functions for an LP, use the Crypto page of the Customize Activation Profiles task. On the Crypto page you can enable the following functions to the LP:

- Public key algorithm (PKA) function
- Cryptographic functions
  - Special secure mode
  - Integrated cryptographic feature (ICRF) key entry
  - Public key secure cable (PKSC) and Integrated Cryptographic Service Facility (ICSF)

- Modify authority (only enabled in one LPAR partition at a time)
- Query signature controls
- Query transport controls

These functions are hierarchically applied. For instance, if you do not enable cryptographic functions for the LP, you cannot enable any of the functions below it on the list. To enable basic ICSF functions, you must select the following parameters on the crypto page:

- Usage domain index

  The number you select for usage domain index must match the domain number that is entered in the installation options data set for this LP.
- Enable cryptographic functions
- Enable public key secure cable (PKSC) and Integrated Cryptographic Service Facility (ICSF)

In addition to the above three parameters, in order to perform key entry on an LP, you must also enable ICRF key entry.

Once an LP is activated, you can then use the Change LPAR Crypto task to change the cryptographic functions that are enabled for that LP. This task has a page for each LP.

Allocating Resources on an ES/9000-9021 (Bipolar) Processor

To give a partition access to the KSU on a bipolar processor you use a PR/SM panel called the Logical Partition Security (LPSEC) frame. The LPSEC frame contains a Key Entry (KE) field for each partition. If a partition's KE field is enabled, the LP can use the KSU. To control access to the KSU, only one LP on the panel can have its KE field enabled. The KE field for all the other LPs must be disabled.

Whether your partition has access to the KSU affects your ability to perform the following tasks:

- Enter the master key
- Enter a key with a Personal Security card
- Enter a key manually through the keypad on the KSU
- Enter a key through the key-entry unit (KEU)
- Check hardware status

If you access the ICSF panels in a partition with KE disabled, you cannot perform master key or key entry. In addition, the status of the KSU key switch position may be incorrect.

Entering the Master Key or Other Keys in LPAR Mode

In an LP with key entry disabled, when you attempt to enter a key or a master key, you cannot access the next panel after the KSU Selection panel. The KSU Selection panel displays an error message, and the physical switch position field on the panel may be incorrect. The panel states that the field may be incorrect as shown in Figure 284 on page 333.

```
CSFMKP10 ---------------- OS/390 ICSF - KSU Selection --- SWITCH POSITION SUSPECT
OPTION ===>

                                                          CRYPTO DOMAIN: 0


KSU/REGISTER STATUS            KSU 0

  Crypto CPs installed       : 1
  Crypto CPs active          :
  Physical switch position   : NORMAL   MAY BE INCORRECT
  Key Part register          : DISABLED AND EMPTY
  New Master Key register    : EMPTY
  NMK verification pattern   :
  Old Master Key register    : EMPTY
  OMK verification pattern   :
  Master Key register        : INVALID
  MK verification pattern    :
  Special Secure Mode        : DISABLED

Press ENTER to refresh the hardware status display.
Press END   to exit to the previous menu.
```

Figure 284. KSU Selection Panel When Partition Has KE Disabled

The physical switch position field states that the switch is in the NORMAL position even if the switch is in another position. However, the other information on the panel is correct.

To perform key entry on an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, you must take one of the following actions:

- Enable the ICRF key entry on the Change LPAR Crypto task page for the LP.
- Use an LP that already has key entry enabled.

To perform key entry on a bipolar processor, you must take one of the following actions:

- Change the KE setting for the current logical partition from disabled to enabled.
- Use the logical partition that already has KE enabled.

Reentering Master Keys After They Were Cleared: In certain situations, ICSF clears the master key registers so the master key value is not disclosed. ICSF clears the master keys in all the logical partitions. The CKDSs and PKDSs are still enciphered under the master keys. To recover the keys in the CKDSs, you must reenter and activate the DES and PKA master keys.

To restore the master keys on an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise, first ensure that key entry is enabled for all usage domain indexes for which you need to reenter the master keys. Since multiple domains can have key entry enabled, the domains may already be enabled. Reenter and activate the master key for all usage domain indexes. You can do this either through the Clear Master Key Part Entry panels or the TKE workstation.

To restore the master keys on a bipolar processor, set MC=Y for one partition and reenter and activate the master key in the KSU. Then select MC=Y for another partition and reenter and activate the master key in the KSU. Continue this process until you have reentered and activated all the master keys.

See “Reentering the Master Key After It was Cleared” on page 180 for information about restoring a master key on ICSF.

Displaying Hardware Status in LPAR Mode

When running in LPAR mode, a combination of the physical switch setting and a control on the LPAR panel determine the physical switch position. Thus, even though the physical switch may be in the NORMAL position, this panel may display the condition as STANDBY as shown in Figure 285. The physical switch setting and the control on the LPAR panel also determine the Special Secure Mode setting. Even though the physical switch may enable the Special Secure Mode, this panel may display it as DISABLED. In these cases, the action you take depends on your processor complex:

- On bipolar processors, examine the physical switch position on the KSU.
- On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise without a TKE workstation, the physical hardware is always enabled, and the hardware Special Secure Mode is always enabled.
- On an S/390 G3 Enterprise Server, or higher or an S/390 Multiprise with a TKE workstation, check the Environmental Control Mask panel to see if the basic crypto function or Special Secure Mode are enabled.

```
CSFMKP10 ------------ OS/390 ICSF - Hardware Status Disp  SWITCH POSITION SUSPECT
OPTION ===>

                                                          CRYPTO DOMAIN: 0


KSU/REGISTER STATUS            KSU 0

  Crypto CPs installed       : 1
  Crypto CPs active          :
  Physical switch position   : STANDBY   MAY BE INCORRECT
  Key Part register          : DISABLED AND EMPTY
  New Master Key register    : EMPTY
  NMK verification pattern   :
  Old Master Key register    : EMPTY
  OMK verification pattern   :
  Master Key register        : INVALID
  MK verification pattern    :
  Special Secure Mode        : DISABLED

Press ENTER to refresh the hardware status display.
Press END   to exit to the previous menu.
```

Figure 285. Hardware Status Display Panel When Partition Has KE Disabled

Appendix D. Notices

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Programming Interface

This ICSF Administrator's Guide is intended to help the ICSF administrator manage the cryptographic keys.

This book primarily documents information that is NOT intended to be used as a Programming Interface of OS/390 ICSF.

This book also documents intended Programming Interfaces that allow the customer to write programs to obtain the services of OS/390 ICSF. This information is identified where it occurs, either by an introductory statement to a chapter or section or by the following marking:

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Glossary

This glossary defines terms and abbreviations used in Integrated Cryptographic Service Facility (ICSF). If you do not find the term you are looking for, refer to the index of the appropriate Integrated Cryptographic Service Facility manual or view *IBM Dictionary of Computing* located at:
http://www.ibm.com/networking/nsg/nsgmain.htm

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Definitions specific to the Integrated Cryptographic Services Facility are labeled “In ICSF.”

A

access method services (AMS). The facility used to define and reproduce VSAM key-sequenced data sets (KSDS). (D)

American National Standard Code for Information Interchange (ASCII). The standard code using a coded character set consisting of 7-bit characters (8 bits including parity check) that is used for information exchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters.

ANSI key-encrypting key (AKEK). A 64- or 128-bit key used exclusively in ANSI X9.17 key management applications to protect data keys exchanged between systems.

ANSI X9.17. An ANSI standard that specifies algorithms and messages for DES key distribution.

ANSI X9.19. An ANSI standard that specifies an optional double-MAC procedure which requires a double-length MAC key.

application program. (1) A program written for or by a user that applies to the user's work, such as a program that does inventory control or payroll. (2) A program used to connect and communicate with stations in a network, enabling users to perform application-oriented activities. (D)

application program interface (API). (1) A functional interface supplied by the operating system or by a separately orderable licensed program that allows an application program written in a high-level language to use specific data or functions of the operating system or the licensed program. (D) (2) In ICSF, a callable service.

asymmetric cryptography. Synonym for public key cryptography. (D)

authentication pattern. An 8-byte pattern that ICSF calculates from the master key when initializing the cryptographic key data set. ICSF places the value of the authentication pattern in the header record of the cryptographic key data set.

authorized program facility (APF). A facility that permits identification of programs authorized to use restricted functions. (D)

B

brass key. A physical key used to turn switches on the key storage unit on a bipolar processor so that the key-entry unit can be used to enter a master key or a clear key.

C

callable service. A predefined sequence of instructions invoked from an application program, using a CALL instruction. In ICSF, callable services perform cryptographic functions and utilities.

CBC. Cipher block chaining.

CDMF. Commercial Data Masking Facility.

CEDA. A CICS transaction that defines resources online. Using CEDA, you can update both the CICS system definition data set (CSD) and the running CICS system.

checksum. (1) The sum of a group of data associated with the group and used for checking purposes. (T) (2) In ICSF, the data used is a key part. The resulting checksum is a two-digit value you enter when you use the key-entry unit to enter a master key part or a clear key part into the key-storage unit.

Chinese Remainder Theorem (CRT). A mathematical theorem that defines a format for the RSA private key that improves performance.

CICS. Customer Information Control System.

cipher block chaining (CBC). A mode of encryption that uses the data encryption algorithm and requires an initial chaining vector. For encipher, it exclusively ORs the initial block of data with the initial control vector and then enciphers it. This process results in the encryption both of the input block and of the initial control vector that it uses on the next input block as the process repeats. A comparable chaining process works for decipher.

ciphertext. (1) In computer security, text produced by encryption. (2) Synonym for enciphered data. (D)

CKDS. Cryptographic Key Data Set.

clear key. Any type of encryption key not protected by encryption under another key.

CMOS. Complementary metal oxide semiconductor.

coexistence mode. An ICSF method of operation during which CUSP or PCF can run independently and simultaneously on the same ICSF system. A CUSP or PCF application program can run on ICSF in this mode if the application program has been reassembled.

Commercial Data Masking Facility (CDMF). A data-masking algorithm using a DES-based kernal and a key that is shortened to an effective key length of 40 DES key-bits. Because CDMF is not as strong as DES, it is called a masking algorithm rather than an encryption algorithm. Implementations of CDMF, when used for data confidentiality, are generally exportable from the USA and Canada.

Common Cryptographic Architecture: Cryptographic Application Programming Interface. Defines a set of cryptographic functions, external interfaces, and a set of key management rules that provide a consistent, end-to-end cryptographic architecture across different IBM platforms.

compatibility mode. An ICSF method of operation during which a CUSP or PCF application program can run on ICSF without recompiling it. In this mode, ICSF cannot run simultaneously with CUSP or PCF.

complementary keys. A pair of keys that have the same clear key value, are different but complementary types, and usually exist on different systems.

console. A part of a computer used for communication between the operator or maintenance engineer and the computer. (A)

control-area split. In systems with VSAM, the movement of the contents of some of the control intervals in a control area to a newly created control area in order to facilitate insertion or lengthening of a data record when there are no remaining free control intervals in the original control area. (D)

control block. (1) A storage area used by a computer program to hold control information. (I) Synonymous with control area. (2) The circuitry that performs the control functions such as decoding microinstructions and generating the internal control signals that perform the operations requested. (A)

control interval. A fixed-length area of direct-access storage in which VSAM stores records and creates distributed free space. Also, in a key-sequenced data set or file, the set of records pointed to by an entry in the sequence-set index record. The control interval is the unit of information that VSAM transmits to or from direct access storage. A control interval always comprises an integral number of physical records. (D)

control interval split. In systems with VSAM, the movement of some of the stored records in a control interval to a free control interval to facilitate insertion or lengthening of a record that does not fit in the original control interval. (D)

control statement input data set. A key generator utility program data set containing control statements that a particular key generator utility program job will process.

control statement output data set. A key generator utility program data set containing control statements to create the complements of keys created by the key generator utility program.

control vector. In ICSF, a mask that is exclusive ORed with a master key or a transport key before ICSF uses that key to encrypt another key. Control vectors ensure that keys used on the system and keys distributed to other systems are used for only the cryptographic functions for which they were intended.

cross memory mode. Synchronous communication between programs in different address spaces that

permits a program residing in one address space to access the same or other address spaces. This synchronous transfer of control is accomplished by a calling linkage and a return linkage.

CRT. Chinese Remainder Theorem.

cryptographic adapter (4755 or 4758). An expansion board that provides a comprehensive set of cryptographic functions for the network security processor and the workstation in the TSS family of products.

cryptographic coprocessor. A microprocessor that adds cryptographic processing functions to specific S/390 Enterprise Servers and S/390 Multiprise processors. The Cryptographic Coprocessor Feature is a tamper-resistant chip built into the processor board. The combination of the Cryptographic Coprocessor Feature and ICSF Version 2 Release 1, or higher, provides secure high-speed cryptographic services in the OS/390 environment.

cryptographic key data set (CKDS). (1) A data set that contains the encrypting keys used by an installation. (D) (2) In ICSF, a VSAM data set that contains all the cryptographic keys. Besides the encrypted key value, an entry in the cryptographic key data set contains information about the key.

cryptography. (1) The transformation of data to conceal its meaning. (2) In computer security, the principles, means, and methods for encrypting plaintext and decrypting ciphertext. (D) (3) In ICSF, the use of cryptography is extended to include the generation and verification of MACs, the generation of MDCs and other one-way hashes, the generation and verification of PINs, and the generation and verification of digital signatures.

CUSP (Cryptographic Unit Support Program). The IBM cryptographic offering, program product 5740-XY6, using the channel-attached 3848.

CUSP/PCF conversion program. A program, for use during migration from CUSP or PCF to ICSF, that converts a CUSP or PCF cryptographic key data set into a ICSF cryptographic key data set.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user written application programs. It includes facilities for building, using, and maintaining databases.

CVC. Card verification code used by MasterCard.

CVV. Card verification value used by VISA.

data encryption algorithm (DEA). In computer security, a 64-bit block cipher that uses a 64-bit key, of which 56 bits are used to control the cryptographic process and 8 bits are used for parity checking to ensure that the key is transmitted properly. (D)

D

data encryption standard (DES). In computer security, the National Institute of Standards and Technology (NIST) Data Encryption Standard, adopted by the U.S. government as Federal Information Processing Standard (FIPS) Publication 46, which allows only hardware implementations of the data encryption algorithm. (D)

data key or data-encrypting key. (1) A key used to encipher, decipher, or authenticate data. (D) (2) In ICSF, a 64-bit encryption key used to protect data privacy using the DES algorithm or the CDMF algorithm.

data set. The major unit of data storage and retrieval, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access. (D)

data-translation key. A 64-bit key that protects data transmitted through intermediate systems when the originator and receiver do not share the same key.

DEA. Data encryption algorithm.

decipher. (1) To convert enciphered data in order to restore the original data. (T) (2) In computer security, to convert ciphertext into plaintext by means of a cipher system. (3) To convert enciphered data into clear data. Contrast with encipher. Synonymous with decrypt. (D)

decode. (1) To convert data by reversing the effect of some previous encoding. (I) (A) (2) In ICSF, to decipher data by use of a clear key.

decrypt. See decipher.

DES. Data Encryption Standard.

diagnostics data set. A key generator utility program data set containing a copy of each input control statement followed by a diagnostic message generated for each control statement.

digital signature. In public key cryptography, information created by using a private key and verified by using a public key. A digital signature provides data integrity and source nonrepudiation.

Digital Signature Standard (DSS). A public key algorithm used only for digital signature.

domain. (1) That part of a network in which the data processing resources are under common control. (T) (2) In ICSF, an index into a set of master key registers.

double-length key. A key that is 128 bits long. A key can be either double- or single-length. A single-length key is 64 bits long.

DSS. Digital Signature Standard.

E

ECB. Electronic codebook.

ECI. Eurochèque International S.C., a financial institution consortium that has defined three PIN block formats.

electronic codebook (ECB) operation. (1) A mode of operation used with block cipher cryptographic algorithms in which plaintext or ciphertext is placed in the input to the algorithm and the result is contained in the output of the algorithm. (D) (2) A mode of encryption using the data encryption algorithm, in which each block of data is enciphered or deciphered without an initial chaining vector. It is used for key management functions and the encode and decode callable services.

electronic funds transfer system (EFTS). A computerized payment and withdrawal system used to transfer funds from one account to another and to obtain related financial data. (D)

encipher. (1) To scramble data or to convert data to a secret code that masks the meaning of the data to any unauthorized recipient. Synonymous with encrypt. (2) Contrast with decipher. (D)

enciphered data. Data whose meaning is concealed from unauthorized users or observers. (D)

encode. (1) To convert data by the use of a code in such a manner that reconversion to the original form is possible. (T) (2) In computer security, to convert plaintext into an unintelligible form by means of a code system. (D) (3) In ICSF, to encipher data by use of a clear key.

encrypt. See encipher.

exit. (1) To execute an instruction within a portion of a computer program in order to terminate the execution of that portion. Such portions of computer programs include loops, subroutines, modules, and so on. (T) (2) In ICSF, a user-written routine that receives control from the system during a certain point in processing—for example, after an operator issues the START command.

exportable form. A condition a key is in when enciphered under an exporter key-encrypting key. In this form, a key can be sent outside the system to another system. A key in exportable form cannot be used in a cryptographic function.

exporter key-encrypting key. A 128-bit key used to protect keys sent to another system. A type of transport key.

F

file. A named set of records stored or processed as a unit. (T)

G

GBP. German Bank Pool.

German Bank Pool (GBP). A German financial institution consortium that defines specific methods of PIN calculation.

H

hashing. An operation that uses a one-way (irreversible) function on data, usually to reduce the length of the data and to provide a verifiable authentication value (checksum) for the hashed data.

header record. A record containing common, constant, or identifying information for a group of records that follows. (D)

I

ICRF. Integrated CRyptographic Feature.

ICSF. Integrated Cryptographic Service Facility.

importable form. A condition a key is in when it is enciphered under an importer key-encrypting key. A key is received from another system in this form. A key in importable form cannot be used in a cryptographic function.

importer key-encrypting key. A 128-bit key used to protect keys received from another system. A type of transport key.

initial chaining vector (ICV). A 64-bit random or pseudo-random value used in the cipher block chaining mode of encryption with the data encryption algorithm.

initial program load (IPL). (1) The initialization procedure that causes an operating system to commence operation. (2) The process by which a configuration image is loaded into storage at the

beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs. (D)

input PIN-encrypting key. A 128-bit key used to protect a PIN block sent to another system or to translate a PIN block from one format to another.

installation exit. See exit.

Integrated Cryptographic Feature (ICRF). The cryptographic hardware available as a feature on specific bipolar processors. The ICRF includes an inboard key storage unit and TCM. The combination of the Integrated Cryptographic Feature and ICSF provides secure high-speed cryptographic services.

Integrated Cryptographic Service Facility (ICSF). A licensed program that runs under MVS/System Product 3.1.3, or higher, or OS/390 Release 1, or higher, and provides access to the hardware cryptographic feature for programming applications. The combination of the hardware cryptographic feature and ICSF provides secure high-speed cryptographic services.

International Organization for Standardization. An organization of national standards bodies from many countries, established to promote the development of standards to facilitate the international exchange of goods and services and to develop cooperation in intellectual, scientific, technological, and economic activity. ISO has defined certain standards relating to cryptography and has defined two PIN block formats.

ISO. International Organization for Standardization.

J

job control language (JCL). A control language used to identify a job to an operating system and to describe the job's requirements. (D)

K

key-encrypting key (KEK). (1) In computer security, a key used for encryption and decryption of other keys. (D) (2) In ICSF, a master key or transport key.

key entry hardware. A generic term referring to the key entry unit (KEU), the Personal Security card, or the keypad on the key storage unit (KSU) on bipolar processors.

key entry unit (KEU). A hand-held hexadecimal key pad used for manually entering the master key and other keys into the Integrated Cryptographic Service Facility on bipolar processors. It plugs into the key storage unit and requires coordination with the ICSF panels.

key generator utility program (KGUP). A program that processes control statements for generating and maintaining keys in the cryptographic key data set.

key output data set. A key generator utility program data set containing information about each key that the key generator utility program generates except an importer key for file encryption.

key part. A 32-digit hexadecimal value that you enter for ICSF to combine with other values to create a master key or clear key.

key part register. A register in the key storage unit that stores a key part while you enter the key part.

key storage unit (KSU). Hardware battery-operated storage that contains the master key and other data in a secure environment, unaffected by system power down.

L

linkage. The coding that passes control and parameters between two routines.

load module. All or part of a computer program in a form suitable for loading into main storage for execution. A load module is usually the output of a linkage editor. (T)

LPAR mode. The central processor mode that enables the operator to allocate the hardware resources among several logical partitions.

M

MAC generation key. A 64-bit or 128-bit key used by a message originator to generate a message authentication code sent with the message to the message receiver.

MAC verification key. A 64-bit or 128-bit key used by a message receiver to verify a message authentication code received with a message.

magnetic tape. A tape with a magnetizable layer on which data can be stored. (T)

master key. (1) In computer security, the top-level key in a hierarchy of key-encrypting keys. (2) In ICSF, there are three types of master keys: the 128-bit DES master key, the 192-bit signature master key, and the 192-bit key management master key. Master keys are known only to the ICSF hardware and maintained in the cryptographic enclosure in a secure fashion. All keys in operational form in the system are enciphered under a master key. Master keys are used only to encrypt other keys.

master key concept. The idea of using a single cryptographic key, the master key, to encrypt all other keys on the system.

master key register. A register in the Cryptographic Coprocessor Feature that stores the master key that is active on the system.

master key variant. A key derived from the master key by use of a control vector. It is used to force separation by type of keys on the system.

MD4. Message Digest 4. A hash algorithm.

MD5. Message Digest 5. A hash algorithm.

message authentication code (MAC). (1) The cryptographic result of block cipher operations on text or data using the cipher block chain (CBC) mode of operation. (D) (2) In ICSF, a MAC is used to authenticate the source of the message, and verify that the message was not altered during transmission or storage.

modification detection code (MDC). (1) A 128-bit value that interrelates all bits of a data stream so that the modification of any bit in the data stream results in a new MDC. (2) In ICSF, an MDC is used to verify that a message or stored data has not been altered.

multiple encipherment. The method of encrypting a key under a double-length key-encrypting key.

N

new master key register. A register in the key storage unit that stores a master key before you make it active on the system.

NIST. U.S. National Institute of Science and Technology.

NOCV processing. Process by which the key generator utility program or an application program encrypts a key under a transport key itself rather than a transport key variant.

noncompatibility mode. An ICSF method of operation during which CUSP or PCF can run independently and simultaneously on the same OS/390 or MVS system. You cannot run a CUSP or PCF application program on ICSF in this mode.

nonrepudiation. A method of ensuring that a message was sent by the appropriate individual.

notarization. The ANSI X9.17 process involving the coupling of an ANSI key-encrypting key (AKEK) with ASCII character strings containing origin and destination identifiers and then exclusive ORing (or offsetting) the result with a binary counter.

O

OAEP. Optimal asymmetric encryption padding.

offset. The process of exclusively ORing a counter to a key.

old master key register. A register in the key storage unit that stores a master key that you replaced with a new master key.

operational form. The condition of a key when it is encrypted under the master key so that it is active on the system.

output PIN-encrypting key. A 128-bit key used to protect a PIN block received from another system or to translate a PIN block from one format to another.

P

PAN. Personal Account Number.

parameter. Data passed between programs or procedures. (D)

parmlib. A system parameter library, either SYS1.PARMLIB or an installation-supplied library.

partial notarization. The ANSI X9.17 standard does not use the term partial notarization. IBM has divided the notarization process into two steps and defined the term partial notarization as a process during which only the first step of the two-step ANSI X9.17 notarization process is performed. This step involves the coupling of an ANSI key-encrypting key (AKEK) with ASCII character strings containing origin and destination identifiers.

partitioned data set (PDS). A data set in direct access storage that is divided into partitions, called members, each of which can contain a program, part of a program, or data. (D)

Personal Account Number (PAN). A Personal Account Number identifies an individual and relates that individual to an account at a financial institution. It consists of an issuer identification number, customer account number, and one check digit.

PCI Cryptographic Coprocessor. The 4758 model 2 standard PCI-bus card supported on the field upgraded IBM S/390 Parallel Enterprise Server - Generation 5 and field upgraded IBM S/390 Parallel Enterprise Server - Generation 6.

| **PCICC**. PCI Cryptographic Coprocessor.

personal identification number (PIN). The 4- to 12-digit number entered at an automatic teller machine to identify and validate the requester of an automatic teller machine service. Personal identification numbers are always enciphered at the device where they are entered, and are manipulated in a secure fashion.

Personal Security card. An ISO-standard “smart card” with a microprocessor that enables it to perform a variety of functions such as identifying and verifying users, and determining which functions each user can perform. The Personal Security card is used to transport key parts that are read into the key storage unit of a suitably equipped ICRF on a bipolar processor.

PIN block. A 64-bit block of data in a certain PIN block format. A PIN block contains both a PIN and other data.

PIN generation key. A 128-bit key used to generate PINs or PIN offsets algorithmically.

PIN key. A 128-bit key used in cryptographic functions to generate, transform, and verify the personal identification numbers.

PIN offset. For 3624, the difference between a customer-selected PIN and an institution-assigned PIN. For German Bank Pool, the difference between an institution PIN (generated with an institution PIN key) and a pool PIN (generated with a pool PIN key).

PIN verification key. A 128-bit key used to verify PINs algorithmically.

PKA. Public Key Algorithm.

PKCS. Public Key Cryptographic Standards (RSA Data Security, Inc.)

PKDS. Public key data set (PKA cryptographic key data set).

plaintext. Data in normal, readable form.

primary space allocation. An area of direct access storage space initially allocated to a particular data set or file when the data set or file is defined. See also secondary space allocation. (D)

private key. In computer security, a key that is known only to the owner and used with a public key algorithm to decrypt data or generate digital signatures. The data is encrypted and the digital signature is verified using the related public key.

processor complex. A configuration that consists of all the machines required for operation.

Processor Resource/Systems Manager. Enables logical partitioning of the processor complex, may provide additional byte-multiplexer channel capability, and supports the VM/XA System Product enhancement for Multiple Preferred Guests.

Programmed Cryptographic Facility (PCF). (1) An IBM licensed program that provides facilities for enciphering and deciphering data and for creating, maintaining, and managing cryptographic keys. (D) (2) The IBM cryptographic offering, program product 5740-XY5, using software only for encryption and decryption.

PR/SM. Processor Resource/Systems Manager.

public key. In computer security, a key made available to anyone who wants to encrypt information using the public key algorithm or verify a digital signature generated with the related private key. The encrypted data can be decrypted only by use of the related private key.

public key algorithm (PKA). In computer security, an asymmetric cryptographic process in which a public key is used for encryption and digital signature verification and a private key is used for decryption and digital signature generation.

public key cryptography. In computer security, cryptography in which a public key is used for encryption and a private key is used for decryption. Synonymous with asymmetric cryptography.

R

RDO. Resource definition online.

record chaining. When there are multiple cipher requests and the output chaining vector (OCV) from the previous encipher request is used as the input chaining vector (ICV) for the next encipher request.

Resource Access Control Facility (RACF). An IBM licensed program that provides for access control by identifying and verifying the users to the system, authorizing access to protected resources, logging the detected unauthorized attempts to enter the system, and logging the detected accesses to protected resources. (D)

| **retained key**. A private key that is generated and
| retained within the secure boundary of the PCI
| Cryptographic Coprocessor.

return code. (1) A code used to influence the execution of succeeding instructions. (A) (2) A value returned to a program to indicate the results of an operation requested by that program. (D)

Rivest-Shamir-Adleman (RSA) algorithm. A process for public key cryptography that was developed by R. Rivest, A. Shamir, and L. Adleman

RMI. Resource Manager Interface (CICS).

RSA. Rivest-Shamir-Adleman.

S

save area. Area of main storage in which contents of registers are saved. (A)

secondary space allocation. In systems with VSAM, area of direct access storage space allocated after primary space originally allocated is exhausted. See also primary space allocation. (D)

Secure Electronic Transaction. A standard created by Visa International and MasterCard for safe-guarding payment card purchases made over open networks.

Secure Sockets Layer. A security protocol that provides communications privacy over the Internet by allowing client/server applications to communicate in a way that is designed to prevent eavesdropping, tampering, or message forgery.

sequential data set. A data set whose records are organized on the basis of their successive physical positions, such as on magnetic tape. (D)

SET. Secure Electronic Transaction.

SHA-1. Secure Hash Algorithm 1, a hash algorithm required for use with the Digital Signature Standard.

single-length key. A key that is 64 bits long. A key can be single- or double-length. A double-length key is 128 bits long.

special secure mode. An alternative form of security that allows you to enter clear keys with the key generator utility program or generate clear PINs.

SSL. Secure Sockets Layer.

supervisor state. A state during which a processing unit can execute input/output and other privileged instructions. (D)

System Authorization Facility (SAF). An interface to a system security system like the Resource Access Control Facility (RACF).

system key. A key that ICSF creates and uses for internal processing.

System Management Facilities (SMF). An optional control program feature of OS/VS that provides the means for gathering and recording information that can be used to evaluate system usage. (D)

T

TKE. Trusted key entry.

Transaction Security System. An IBM product offering including both hardware and supporting software that provides access control and basic cryptographic key-management functions in a network environment. In the workstation environment, this includes the 4755 Cryptographic Adapter, the Personal Security Card, the 4754 Security Interface Unit, the Signature Verification feature, the Workstation Security Services Program, and the AIX Security Services Program/6000. In the host environment, this includes the 4753 Network Security Processor and the 4753 Network Security Processor MVS Support Program.

transport key. A 128-bit key used to protect keys distributed from one system to another. A transport key can either be an exporter key-encrypting key, an importer key-encrypting key, or an ANSI key-encrypting key.

transport key variant. A key derived from a transport key by use of a control vector. It is used to force separation by type for keys sent between systems.

TRUE. Task-related User Exit (CICS). The CICS-ICSF Attachment Facility provides a CSFATRUE and CSFATREN routine.

U

UDF. User-defined function.

UDK. User-derived key.

V

verification pattern. An 8-byte pattern that ICSF calculates from the key parts you enter when you enter a master key or clear key. You can use the verification pattern to verify that you have entered the key parts correctly and specified a certain type of key.

Virtual Storage Access Method (VSAM). (1) An IBM licensed program that controls communication and the flow of data in an SNA network. It provides single-domain, multiple-domain, and interconnected network capability. (D) (2) An access method for indexed or sequential processing of fixed and variable-length records on direct-access devices. The records in a VSAM data set or file can be organized in logical sequence by means of a key field (key sequence), in the physical sequence in which they are

written on the data set or file (entry-sequence), or by means of relative-record number.

VISA. A financial institution consortium that has defined four PIN block formats and a method for PIN verification.

VISA PIN Verification Value (VISA PVV). An input to the VISA PIN verification process that, in practice, works similarly to a PIN offset.

Numerics

3621. A model of an IBM Automatic Teller Machine that has a defined PIN block format.

3624. A model of an IBM Automatic Teller Machine that has a defined PIN block format and methods of PIN calculation.

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Administrator's Guide

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