IBM

3906 Installation Manual for Physical Planning
All Models

Level 01c

GC28-6965-01

Note:

Before you use this information and the product it supports, read the information in "Safety" on page vii, Appendix E, "Notices," on page 191, and *Systems Environmental Notices and User Guide*, Z125-5823.

This edition, GC28-6965-01c, applies to the 3906 server. This edition replaces GC28-6965-01b.

There may be a newer version of this document in a **PDF** file available on **Resource Link**. Go to *http://www.ibm.com/servers/resourcelink* and click **Library** on the navigation bar. A newer version is indicated by a lowercase, alphabetic letter following the form number suffix (for example: 00a, 00b, 01a, 01b).

Contents

Safety

Safety notices

Safety notices may be printed throughout this guide. **DANGER** notices warn you of conditions or procedures that can result in death or severe personal injury. **CAUTION** notices warn you of conditions or procedures that can cause personal injury that is neither lethal nor extremely hazardous. **Attention** notices warn you of conditions or procedures that can cause damage to machines, equipment, or programs.

Danger notices

DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

World trade safety information

Several countries require the safety information contained in product publications to be presented in their translation. If this requirement applies to your country, a safety information booklet is included in the publications package shipped with the product. The booklet contains the translated safety information with references to the US English source. Before using a US English publication to install, operate, or service this product, you must first become familiar with the related safety information in the *Systems Safety Notices*, G229-9054. You should also refer to the booklet any time you do not clearly understand any safety information in the US English publications.

Laser safety information

All IBM Z® (Z) and IBM® LinuxONE (LinuxONE) models can use I/O cards such as FICON®, Open Systems Adapter (OSA), InterSystem Channel-3 (ISC-3), RoCE Express, Integrated Coupling Adapter (ICA SR), zHyperLink Express, or other I/O features which are fiber optic based and utilize lasers (short wavelength or long wavelength lasers).

Laser compliance

All lasers are certified in the US to conform to the requirements of DHHS 21 CFR Subchapter J for Class 1 or Class 1M laser products. Outside the US, they are certified to be in compliance with IEC 60825 as a Class 1 or Class 1M laser product. Consult the label on each part for laser certification numbers and approval information.

CAUTION: Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. (C027)

CAUTION: This product contains a Class 1M laser. Do not view directly with optical instruments. (C028)

About this publication

This publication contains information necessary for planning the physical installation of the 3906.

Unless otherwise stated, throughout this document "3906" refers to z14 and Emperor II.

Figures included in this document illustrate concepts and are not necessarily accurate in content, appearance, or specific behavior.

- Chapter 1, “Introduction,” on page 1 provides an introduction to planning for your system and a planning checklist.
- Chapter 2, “Environmental specifications,” on page 11 contains important computer room environmental information.
- Chapter 3, “Models and physical specifications,” on page 27 gives plan views, service clearances, weight distribution, and cooling information for the system.
- Chapter 4, “Guide for raised floor preparation,” on page 97 contains information on preparation of the raised floor.
- Chapter 5, “Power requirements,” on page 103 provides power and internal battery feature information.
- Chapter 6, “Hardware Management Console and Support Element communications,” on page 125 includes information on hardware management console and support element communications.
- Chapter 7, “Remote Support Facility (RSF) installation planning,” on page 133 contains Remote Support Facility installation planning.
- Chapter 8, “I/O cabling and connectivity ,” on page 135 discusses cable connectivity information.
- Chapter 9, “Parallel sysplex planning,” on page 165 provides information to build a Parallel Sysplex®.
- The Appendices provide information on IBM standard symbols, Hardware Management Console specifications, 3-phase dual power installation, and balancing power loads.

Related publications

IBM publications that you will find helpful and that you should use along with this publication are in the following list. You can access these books from Resource Link® at *http://www.ibm.com/servers/resourcelink*, and click **Library** from the navigation bar on the left. Then select the server product.

- *Systems Safety Notices*, G229-9054
- *Environmental Notices and User Guide*, Z125-5823
- *3906 Installation Manual*, GC28-6964
- *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*, GA23-1408
- *FICON Channel-to-Channel Reference*, SB10-7174
- *Open System Adapter-Express3 Integrated Console Controller Dual-Port User's Guide* , SA23-2266
- *Open Systems Adapter-Express Customer's Guide and Reference*, SA22-7935

In addition to these references, there is also general computer room planning information on IBM's Resource Link (http://www.ibm.com/servers/resourcelink).

Related HMC and SE console information

Hardware Management Console (HMC) and Support Element (SE) information can be found on the console help system.

Licensed Machine Code

Licensed Machine Code is provided in accordance with the terms and conditions of the applicable IBM Customer Agreement or other applicable written agreement between the customer and IBM.

Licensed Machine Code (LMC) is a fundamental component of the 3906 and is copyrighted and licensed by IBM. Each 3906 is delivered with Licensed Machine Code that is customized to the specific machine ordered. The Licensed Machine Code enables the server to operate in accordance with its Official Published Specifications.

Model upgrades, feature additions, and system engineering changes may require updated Licensed Machine Code for the system. Updated Licensed Machine Code replaces the existing Licensed Machine Code.

Relocation of a 3906 requires that the Licensed Machine Code be reinstalled in the server at the new location. Refer to the "Discontinuing the System" section of the *3906 Installation Manual* for the procedure for relocating a 3906.

Accessibility

Accessible publications for this product are offered in EPUB format and can be downloaded from Resource Link at http://www.ibm.com/servers/resourcelink.

If you experience any difficulty with the accessibility of any IBM Z and IBM LinuxONE information, go to Resource Link at http://www.ibm.com/servers/resourcelink and click **Feedback** from the navigation bar on the left. In the **Comments** input area, state your question or comment, the publication title and number, choose **General comment** as the category and click **Submit**. You can also send an email to reslink@us.ibm.com providing the same information.

When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

Accessibility features

The following list includes the major accessibility features in IBM Z and IBM LinuxONE documentation, and on the Hardware Management Console and Support Element console:

- Keyboard-only operation
- Interfaces that are commonly used by screen readers
- Customizable display attributes such as color, contrast, and font size
- Communication of information independent of color
- Interfaces commonly used by screen magnifiers
- Interfaces that are free of flashing lights that could induce seizures due to photo-sensitivity.

Keyboard navigation

This product uses standard Microsoft Windows navigation keys.

Consult assistive technologies

Assistive technology products such as screen readers function with our publications, the Hardware Management Console, and the Support Element console. Consult the product information for the specific assistive technology product that is used to access the EPUB format publication or console.

IBM and accessibility

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

How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. Send your comments by using Resource Link at http://www.ibm.com/servers/resourcelink. Click **Feedback** on the navigation bar on the left. You can also send an email to reslink@us.ibm.com. Be sure to include the name of the book, the form number of the book, the version of the book, if applicable, and the specific location of the text you are commenting on (for example, a page number, table number, or a heading).

Revisions

A technical change from the previous edition of this document is indicated by a thick vertical line to the left of the change.

Summary of changes

Summary of changes for the *3906 Installation Manual for Physical Planning*, GC28-6965.

Table 1. Summary of changes

Release Level	Changes in Level
01c	This revision contains editorial changes and the following technical changes: • New topic, "Planning to load images to a system from a network (electronic code load)" on page 132, added to "Chapter 6. Hardware Management Console and Support Element communications".
01b	This revision contains editorial changes and the following technical changes: • Important note added to Chapter 2, "Environmental specifications," on page 11 regarding the status of the EPO switch.
01a	This revision contains editorial changes and the following technical changes: • Important note added to "IBM Adapter for NVMe (FC 0435)" on page 153
01	This revision contains editorial changes and the following technical changes: • Changes to the "Planning checklist" on page 2 and "z/OS HCD" on page 162 to include Dynamic I/O for Standalone Coupling Facility considerations. • Important note added to Chapter 3, "Models and physical specifications," on page 27. • "Trusted Key Entry (TKE)" on page 129 is updated to include TKE 9.1 License Internal Code enhancements. • "FICON channel features" on page 139 is updated to include the following new features for IBM LinuxONE Emperor II only: – FCP Express32S LX (FC 0438) – FCP Express32S SX (FC 0439) • "OSA-Express features" on page 141 is updated to include the new OSA-Express7S 25 GbE feature (FC 0429) • "Native PCIe adapters" on page 149 is updated to include the following new features: – 25 GbE RoCE Express2 (FC 0430) added to "IBM RoCE Express and RoCE Express2" on page 149 – "IBM Adapter for NVMe (FC 0435)" on page 153 - IBM LinuxONE Emperor II only

Chapter 1. Introduction

This chapter is intended to help you prepare your physical site for the installation of a 3906. Marketing and installation planning representatives are also available to help you with installation planning. Proper planning for your new system will facilitate a smooth installation and fast system startup.

The use of the terms, "server", "processor", "system" and "all models" in this publication refer to the 3906.

System planning

As part of your system planning activity, you will make decisions about where to locate your equipment, who will operate the system, and so on. A good plan ensures that the equipment and materials are ready to use when the 3906 arrives.

The type of software (operating system and application programs) that you intend to use must support the features and devices on the system. You should already be familiar with your software requirements, but may want to contact your IBM marketing representative for information on planning for the software.

Planning for a new computer room

A detailed step-by-step procedure for physically planning a computer room installation is located on the **General Information for Planning a Physical Site** page on Resource Link (http://www.ibm.com/servers/resourcelink). On the left navigation pane, click **Planning**, **Physical Planning**, and **General information for planning a physical site** (located under **zSeries & S/390®**).

Planning checklist

The following checklist identifies installation tasks and responsibilities sequentially, and is designed for new installations. If you have to renovate your site, you may need a longer planning cycle.

Site Preparation Checklist

Task/Consideration	Task Assigned ( ) ✓	Target Date	Completed
CHECKPOINT 1			
Designate a person in your organization with the responsibility for all phases of site preparation for this system installation	☐	_____	_____
Review all site planning information with the designated person	☐	_____	_____
Determine who will actually perform each site preparation task and who will control the marking of this checklist	☐	_____	_____
Identify communication needs, including Remote Support Facility, cables, switches, telephones, connection panels, etc	☐	_____	_____
In the Chapter titled, "I/O cabling and connectivity" (in this document), read the information about planning now for future cabling needs. In the same chapter, also read "IBM Site and Facilities Services"	☐	_____	_____
Identify channel needs including: cables, directors, switches, patch panels, etc	☐	_____	_____
Identify other machine/device needs including: changes to any existing equipment	☐	_____	_____
Determine the schedule with your IBM marketing representative and fill in the target dates on this checklist	☐	_____	_____
CHECKPOINT 2			
Lay out the floor plan. Include stationary obstacles, walls, all computer equipment, locations for power, lighting, heating and cooling, water and fire detection and extinguishing equipment	☐	_____	_____
If the level of acoustical noise is a concern, consider arranging the floor layout to avoid areas of excessive noise exposure to employees, and possibly utilize noise control screens or other treatments to reduce noise levels. Some IBM servers have available acoustic doors to reduce noise. Check with your marketing representative to see if your server has such options.	☐	_____	_____
If this is a new computer room, see the course, *General information for planning the physical site* under "Planning --> Physical Planning" on Resource Link (*http://www.ibm.com/servers/resourcelink*)	☐	_____	_____
To assist in site planning, a 3-D graphic file to be used with CAD software is available on Resource Link (*http://www.ibm.com/servers/resourcelink*). Click "Planning / Physical Planning." Then under the specific machine, click "STP 3-D graphic files."	☐	_____	_____
Order communication equipment cables, modems, switches, telephones, connection panels, etc	☐	_____	_____
Order channel equipment cables, directors, switches, patch panels, etc. In the Chapter titled, "I/O cabling and Connectivity" (in this document), read the information about "IBM Site and Facilities Services" and "Customer fiber optic cabling responsibilities" to determine your cabling requirements and responsibilities. Your IBM marketing representative can assist you with this task. Other parts of this chapter include fiber optic channel and adapter descriptions and information about the Fiber Quick Connect feature for FICON channels.	☐	_____	_____
If you are planning for a system that will use FICON channels, InfiniBand, coupling links, or Open System Adapters (OSA), contact your IBM marketing representative to obtain the document, *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*, GA23-1408	☐	_____	_____
Order other machines/devices, including changes to any existing equipment.	☐	_____	_____
Order the *Earthquake kit - Frame-stiffening and tie-down* feature if you require frame ruggedizing to secure the frame(s) and its contents from damage when exposed to vibrations and shocks as those in a seismic event.	☐	_____	_____

Site Preparation Checklist

Task/Consideration	Task Assigned (✓)	Target Date	Completed
CHECKPOINT 3			
The computer room is prepared for computer equipment service clearance and floor loading, physical placement based on logical priority, cabling restrictions, and shock and vibration considerations, and electromagnetic compatibility/interference If the *Earthquake kit - Frame-stiffening and tie-down* feature was ordered, install the following Raised floor: 4 eyebolts per frame in concrete floor Non-raised floor: 5 anchors per lockdown plate in concrete floor	☐	_____	_____
Emergency and backup operations planning includes provisions for fire detection, prevention, extinguishing, and control equipment, and storm protection and damage recovery procedures	☐	_____	_____
There is workspace around equipment, including passageways for movement of people and machines, and includes consideration for lighting and possible areas of high acoustic noise	☐	_____	_____
Office equipment and space, including furniture, vending, meeting, and entrance/exit areas have adequate lighting, heating/cooling, and acoustics	☐	_____	_____
Material and data storage provisions have been satisfied	☐	_____	_____
Schedule and make changes to existing programs as required	☐	_____	_____
Schedule and make changes to existing machines/devices as required	☐	_____	_____
Arrange for installation of cables between work stations, controllers, modems, switches, etc	☐	_____	_____
Arrange for installation of new power receptacles and wiring	☐	_____	_____
Define a training program for employees	☐	_____	_____
CHECKPOINT 4			
Computer room power should be completed. electrically clean, dedicated circuits for all computer equipment sufficient power provided to avoid outages caused by power transients protection from lightning damage	☐	_____	_____
Backup power batteries or generators, if required	☐	_____	_____
Branch circuits, grounding, conduits, phase rotation, emergency controls, to local electrical code and equipment guidelines	☐	_____	_____
An adequate number of computer equipment and convenience outlets have been provided in the locations where they are to be used	☐	_____	_____
Computer room personnel are adequately trained in power procedures, including emergency situations	☐	_____	_____
Review the progress of the communications, channel, and adapter cabling. Identify and resolve problems and schedule conflicts	☐	_____	_____
Review the system configuration to make sure there are no physical problems and that the configuration meets your needs.	☐	_____	_____

Site Preparation Checklist

Task/Consideration	Task Assigned (✓)	Target Date	Completed
CHECKPOINT 5			
Air conditioning installation is complete capacity and controls provided for automatic temperature and humidity levels filtration system is adequate and maintenance plan established regular monitoring and testing	☐	_____	_____
Training for computer room personnel	☐	_____	_____
If you have elected to do your own I/O cabling, as cables begin to arrive, start installing and labeling them. Label power receptacles as they are installed	☐	_____	_____
Complete the Systems Assurance Product Review with your marketing representative or Business Partner and the system installers	☐	_____	_____
Carefully measure the delivery path from the shipper drop-off point to the raised floor install location. Accurate measurements now may prevent installation delays later	☐	_____	_____
CHECKPOINT 6			
Complete communication equipment installation, cables, modems, switches, telephones, connection panels, etc	☐	_____	_____
Complete the Remote Support Facility installation LAN and communication cables, switches, patch panels, etc	☐	_____	_____
Prepare IOCP input statements or HCD definitions	☐	_____	_____
If you are planning to use the Dynamic I/O for Standalone Coupling Facility, this configuration must be defined in HCD	☐	_____	_____
Use the CHPID Mapping Tool on Resource Link to help assign PCHIDs to CHPIDs	☐	_____	_____
If you have elected to do your own I/O cabling, complete the checkout of system cables as much as possible. Verify that the cables are properly routed, protective end caps are in place, that the processor ends of the cables are safely out of the way for system installation, and that cable safety procedures are followed	☐	_____	_____
Complete the checkout of the power cables. Test for continuity and polarity, proper grounding, correct phase wiring, and general power safety considerations	☐	_____	_____
Complete the required changes to the existing programs and data processing units	☐	_____	_____
Install communication facilities, such as telephone lines	☐	_____	_____

Site Preparation Checklist

Task/Consideration	Task Assigned (✓)	Target Date	Completed
CHECKPOINT 7			
Are there any new applications that must be installed/ tested before the new system arrives?	☐	_____	_____
Do you need to conduct training with computer room personnel:			
- Safety?	☐	_____	_____
- Security?	☐	_____	_____
- Operations?	☐	_____	_____
- Other?	☐	_____	_____
Are there any outstanding hardware changes that need to be made to existing:			
- Computer equipment?	☐	_____	_____
- Communications equipment?	☐	_____	_____
- Site facilities?	☐	_____	_____
Is the system configuration ready for installation:			
- IOCP input?	☐	_____	_____
- CHPIDs?	☐	_____	_____
Do you have a comprehensive channel cabling plan in place:			
- Are all cables either ordered or on hand?	☐	_____	_____
- Do you have a reliable installer ready to go?	☐	_____	_____
- Are plans in place for cable connection at remote devices?	☐	_____	_____
- Is there a system test plan?	☐	_____	_____
- Are you prepared to provide cable labels or labeling information?	☐	_____	_____
- Are protective end cap devices in place on all cable connectors?	☐	_____	_____
- Are cables routed and coiled out of the way for installation?	☐	_____	_____
Is the path for moving the new equipment:			
- Wide enough?	☐	_____	_____
- High enough?	☐	_____	_____
- Free of obstructions?	☐	_____	_____
- Ramps ready, if necessary?	☐	_____	_____
Are floor panels ready? If the *Earthquake kit - Frame-stiffening and tie-down* feature was ordered, has the following hardware been installed? Raised floor: 4 eyebolts per frame in concrete floor Non-raised floor: 5 anchors per lockdown plate in concrete floor	☐	_____	_____
Is all furniture and miscellaneous equipment in place or out of the way for installation?	☐	_____	_____
Is your setup team trained and ready for the arrival of the new equipment?	☐	_____	_____
Complete the site preparation	☐	_____	_____
ARRIVAL OF NEW EQUIPMENT			
Move unit(s) to installation location.	☐	_____	_____
Place the units according to machine clearance dimensions provided in "Machine and service clearance areas" (in this document).	☐	_____	_____
Unpack unit(s) according to instructions.	☐	_____	_____
Call your service provider to install the unit(s).	☐	_____	_____

Customized planning aid

A customized planning aid will be available for your system one day after receipt of your order in manufacturing. You may obtain access to this aid by registering on Resource Link. This planning aid will include unique physical planning requirements based on your system's specific configuration.

It is important to note here that the planning aid is not intended to replace this manual. You should be familiar with the contents of this document before you attempt to use the planning aid.

ASHRAE declarations - radiator-cooled

ASHRAE Declarations (Metric) for 3906 (Radiator-cooled)

ASHRAE Class A3 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 9)	Maximum Dry Bulb Temperature (3)	Maximum Dew Point (9)
	kW	m3/hr	m3/hr	kg	W x D x H (cm)	m	C°	C°
Minimum Configuration Model M01 FC 1023 or Model LM1 FC 1107	6.5	1891	3267	1357	156.8 x 186.9 x 201.5	3048	40	24
Maximum Configuration Model M05 FC 1027 or Model LM5 FC 1111	21.5	4995	7509	2522	156.8 x 186.9 x 201.5	3048	40	24

ASHRAE Declarations (English) for 3906 (Radiator-cooled)

ASHRAE Class A3 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 9)	Maximum Dry Bulb Temperature (3)	Maximum Dew Point (9)
	kBTU/hr	cfm	cfm	lbs	W x D x H (in)	ft	F°	F°
Minimum Configuration Model M01 FC 1023 or Model LM1 FC 1107	22.2	1113	1923	2993	61.7 x 73.6 x 79.3	10,000	104	75.2
Maximum Configuration Model M05 FC 1027 or Model LM5 FC 1111	73.4	2940	4420	5559	61.7 x 73.6 x 79.3	10,000	104	75.2

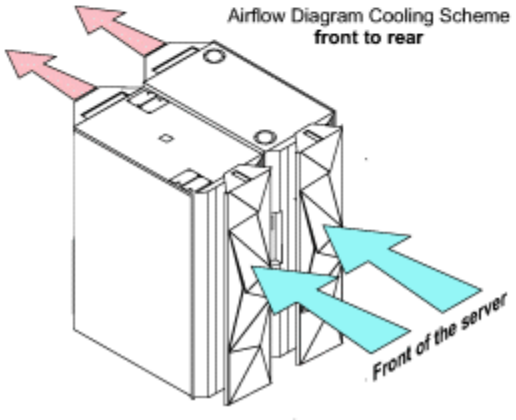


Figure 1. ASHRAE declarations - radiator-cooled

Notes:

1. Airflow is designed to increase as the local ambient room temperature increases. Nominal airflow assumes 25º C (77º F) ambient. Maximum airflow is based on an ambient of 40º C (104º F) and an elevation of 900 m (3000 ft) for all models.
2. Weights provided assume the optional Integrated Battery Features are installed.
3. For ambient temperatures exceeding 25º C (77º F), the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See “Acoustics” on page 23 for the declared acoustical noise emission levels for the system under nominal temperature conditions of 23º C plus or minus 2º C (73.4º F plus or minus 3.6º F).
4. Maximum ambient reduces 1º C (1.8º F) for every 175 m (574 ft) over 900 m (2953 ft).
5. Weights are approximately maximum for populated frames except where indicated below.
6. Weights do not include covers. For standard covers, add approximately 104.8 kg (231 lbs) to each frame. For the thin covers on z14 radiator-cooled models, add approximately 63.5 kg (140 lbs) to each frame.
7. The top exit I/O cable towers will add approximately 35.4 kg (78 lbs) to each frame.
8. The top exit I/O cable towers will add 305 mm (12 inches) to the width. If the optional cable management brackets are used, the overall system height will increase. See “Top exit I/O cabling” on page 135 for details.
9. See the elevation label () or tropical climate label () in the *Systems Safety Notices* document to determine **if** there are any elevation limitations or tropical climate limitations for your country.

ASHRAE declarations - water-cooled

ASHRAE Declarations (Metric) for 3906 (Water-cooled)

ASHRAE Class A3 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7, 9)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 10)	Maximum Dry Bulb Temperature (3)	Maximum Dew Point (10)
	kW	m3/hr	m3/hr	kg	W x D x H (cm)	m	C°	C°
Minimum Configuration Model M01 FC 1028 or Model LM1 FC 1112	6.1	1140	1783	1407	156.8 x 197.1 x 201.5	3048	40	24
Maximum Configuration Model M05 FC 1032 or Model LM5 FC 1116	20.1	3038	5148	2572	156.8 x 197.1 x 201.5	3048	40	24

ASHRAE Declarations (English) for 3906 (Water-cooled)

ASHRAE Class A3 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7, 9)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 10)	Maximum Dry Bulb Temperature (3)	Maximum Dew Point (10)
	kBTU/hr	cfm	cfm	lbs	W x D x H (in)	ft	F°	F°
Minimum Configuration Model M01 FC 1028 or Model LM1 FC 1112	20.8	670	1049	3103	61.7 x 77.7 x 79.3	10,000	104	75.2
Maximum Configuration Model M05 FC 1032 or Model LM5 FC 1116	68.6	1788	3030	5669	61.7 x 77.7 x 79.3	10,000	104	75.2

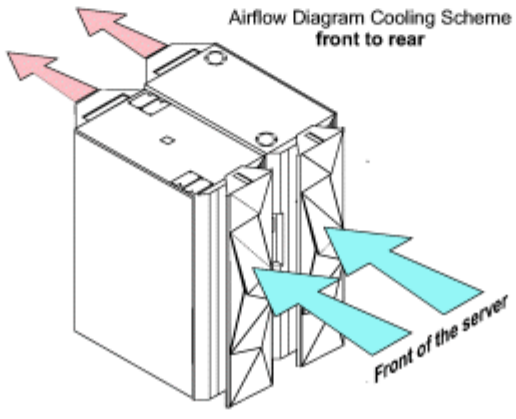


Figure 2. ASHRAE declarations - water-cooled

Notes:

1. Airflow is designed to increase as the local ambient room temperature increases. Nominal airflow assumes 25º C (77º F) ambient. Maximum airflow is based on an ambient of 40º C (104º F) and an elevation of 900 m (3000 ft) for all models.
2. Weights provided assume the optional Integrated Battery Features are installed.
3. For ambient temperatures exceeding 25º C (77º F), the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See “Acoustics” on page 23 for the declared acoustical noise emission levels for the system under nominal temperature conditions of 23º C plus or minus 2º C (73.4º F plus or minus 3.6º F).
4. Maximum ambient reduces 1º C (1.8º F) for every 175 m (574 ft) over 900 m (2953 ft).
5. Weights are approximately maximum for populated frames except where indicated below.
6. Weights do not include covers. For standard covers, add approximately 104.8 kg (231 lbs) to each frame.
7. The top exit I/O cable towers will add approximately 35.4 kg (78 lbs) to each frame.
8. The top exit I/O cable towers will add 305 mm (12 inches) to the width. If the optional cable management brackets are used, the overall system height will increase. See “Top exit I/O cabling” on page 135 for details.
9. Weights for the water cooled option are dry weights. When filled, water will add 22.7 kg (50 lbs) to the total.
10. See the elevation label () or tropical climate label () in the *Systems Safety Notices* document to determine **if** there are any elevation limitations or tropical climate limitations for your country.

Chapter 2. Environmental specifications

The 3906 is among the most powerful group of mainframe processors ever built. Technology improvements have placed these machines in the top levels of Reliability, Availability, and Serviceability. But it takes more than premium computer equipment to achieve these goals. The data center environment must be able to support the demands that the 3906 capability requires. On the following pages, environmental specifications are presented in tabular and graphic forms to emphasize how important it is that you provide the conditions necessary to utilize all of the power the 3906 offers.

The 3906 operates in an ASHRAE Class A3 environment per the ASHRAE Thermal Guidelines for Data Processing Environments, 3rd Edition.

Environmental specifications are presented in two categories: Recommended and Allowable. Obviously, meeting these specifications is prerequisite to using the 3906. It is strongly suggested that you strive for a long-term operating environment within the recommended specification range. The powerful computing the 3906 provides generates heat that must be removed from the server. Operating your data center most of the time within the recommended specification ranges instead of the allowable range will enhance its overall resiliency, energy efficiency, and reliability.

Unless otherwise noted on individual specification pages, the following environmental specifications, based on an altitude from sea level to 900 meters (2953 feet), apply:

Table 2. Environmental specifications - table format		
Environment, operating [9]		
	Recommended [1]	**Allowable [2,3,4,5,6]**
Temperature	18°C - 27°C (64.4°F - 80.6°F)	5°C - 40°C (41°F - 104°F)
Low end moisture	5.5°C (41.9°F) dew point	-12°C (10.4°F) dew point and 8% relative humidity
High end moisture	60% relative humidity and 15°C (59°F) dew point	24°C (72.5°F) dew point and 85% relative humidity
Gaseous contamination	Severity level G1 according to ANSI/ISA 71.04-1985 [7,8]	
Particulate contamination	Cleanliness level of ISO 14644-1 Class 8 [8]	
Allowable environment, nonoperating [10]		
Temperature	5°C (45°F) to 45°C (113°F)	
Relative humidity	8% - 85%	
Maximum dew point	27°C (80.6°F)	
Gaseous contamination	Severity level G1 according to ANSI/ISA 71.04-1985 [7, 8]	
Environment, shipping [9]		
Temperature	-40°C (-40°F) to 60°C (140°F)	
Relative humidity	5% - 100% (no condensation)	
Maximum web bulb temperature	29°C (84.2°F)	
Shipping package	IBM-approved crate with vapor barrier bag with desiccant	
Environment, storage:		
Temperature	1°C (33.8°F) to 60°C (140°F)	
Relative humidity	5% -80% (no condensation)	
Web bulb	29°C (84.2°F)	
Shipping package	IBM-approved crate with vapor barrier bag with desiccant	

Notes:

1. The recommended operating environment specifies a long-term operating environment that can result in the greatest resiliency, energy efficiency, and reliability.
2. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation (e.g. in the case of a cooling failure).
3. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).
4. The minimum humidity level is the larger absolute humidity of the -12°C (10.4°F) dew point and the 8% relative humidity. These intersect at approximately 25°C (77°F). Below this intersection the dew

point (-12°C) represents the minimum moisture level, while above it, the relative humidity (8%) is the minimum. See Figure 3 on page 14 for a graphical explanation of the envelope.

5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See “Acoustics” on page 23 for the declared acoustical noise emission levels for the system.
6. Moisture levels lower than 0.5°C (32.9°F) dew point, but not lower than the low end moisture limit, can be accepted if appropriate control measures are implemented to limit the generation of static electricity on personnel and equipment in the data center. All personnel and mobile furnishings/ equipment must be connected to the ground via an appropriate static control system. The following items are considered the minimum requirements:
   a. Conductive materials
      1) Conductive flooring
      2) Conductive footwear on all personnel that go into the data center, including visitors
      3) All mobile furnishings/equipment to be made of conductive or static dissipative materials.
   b. During maintenance on any hardware, a properly functioning wrist strap must be used by personnel who contacts the system.
7. ANSI/ISA-S71.04. 1985. "Environmental conditions for process measurement and control systems: Airborne contaminants." Instrument Society of America, Research Triangle Park, NC, 1985.
8. See “Conductive contamination” on page 20 for details of the requirements for gaseous and particulate contamination.
9. See “System acclimation” on page 17 for guidance on how long the system must be acclimated before being attached to power.
10. Equipment has been removed from original shipping container and installed but powered down. The allowable non-operating environment is provided to define the environmental range that an non-powered system should be able to experience short-term without being damaged. It assumes that the system has not been contaminated with low deliquescent relative humidity dust, which could damage the equipment and require the system to dry out before powering on. (See “Conductive contamination” on page 20 for details.) Under all conditions, the environment must remain non-condensing. The allowable non-operating environment is meant for abnormal conditions (ie. power or cooling failure). It is expected that the data center will return conditions to the recommended operating conditions within a short period of time. The allowable non-operating environment is not meant to be used for periodic, planned changes from an operating to non-operating condition.
11. The status of the EPO switch (**OFF** or **ON**) does not designate whether the system is considered to be *operating* or *non-operating*.
    - A *non-operating* system is defined as a system that does not have energized power/line cords attached to it
    - An *operating* system is defined as a system that does have energized power/line cords attached to it.

Figure 3 on page 14 shows the environmental specifications in **line graph** format.

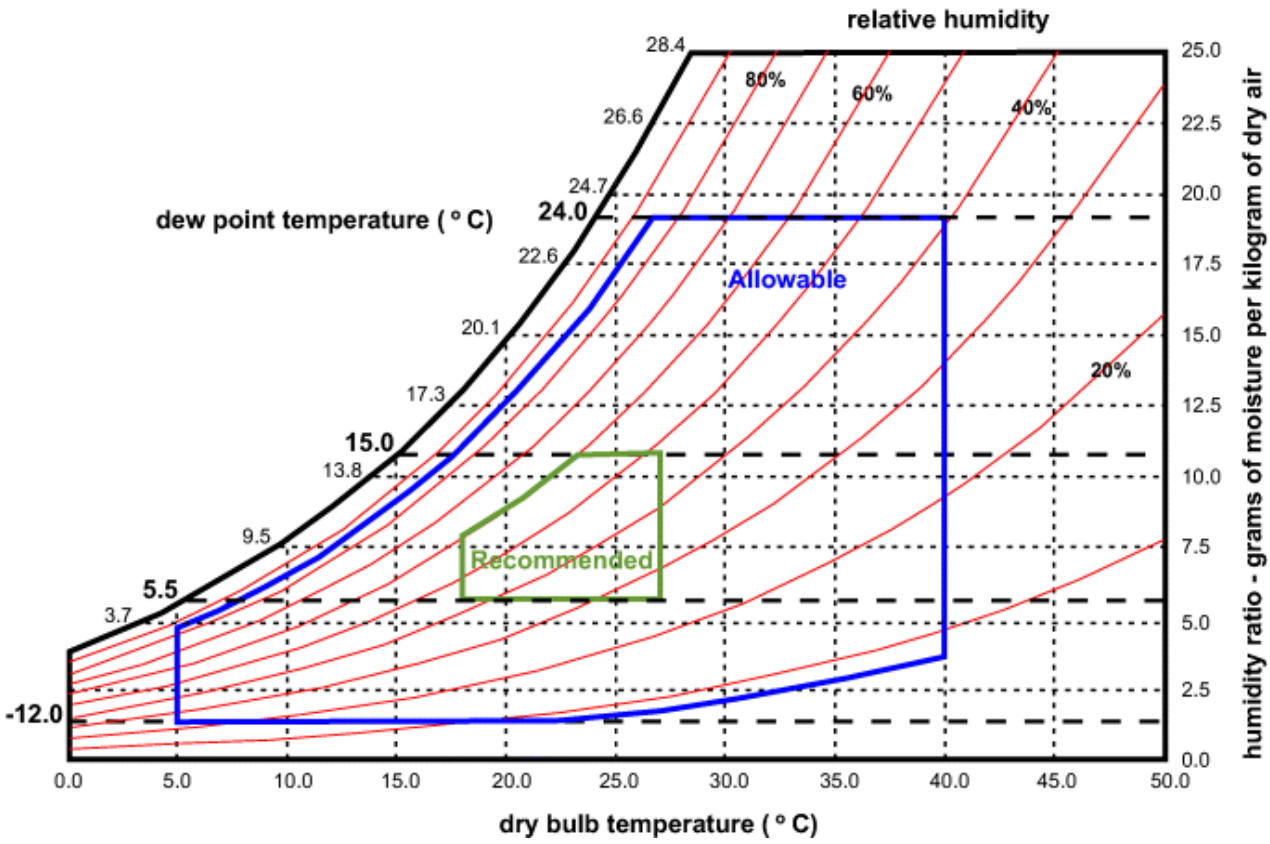


Figure 3. Environmental operating specifications - line graph format

Notes:

1. Psychometric chart is shown in SI (metric) units and a barometric pressure 101.325 kPa (sea level).
2. The recommended operating environment specifies a long-term operating environment that can result in the greatest reliability and energy efficiency.
3. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation, for example in the case of a cooling failure.
4. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).
5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See “Acoustics” on page 23 for the declared acoustical noise emission levels for the system.
6. Moisture levels lower than 0.5°C (32.9°F) dew point, but not lower than the low end moisture limit, can be accepted if appropriate control measures are implemented to limit the generation of static electricity on personnel and equipment in the data center. All personnel and mobile furnishings/ equipment must be connected to the ground via an appropriate static control system. The following items are considered the minimum requirements:
   a. Conductive materials
      1) Conductive flooring
      2) Conductive footwear on all personnel that go into the data center, including visitors
      3) All mobile furnishings/equipment to be made of conductive or static dissipative materials.

b. During maintenance on any hardware, a properly functioning wrist strap must be used by personnel who contacts the system.

Figure 4 on page 16 shows the environmental specifications in **bar graph** format.

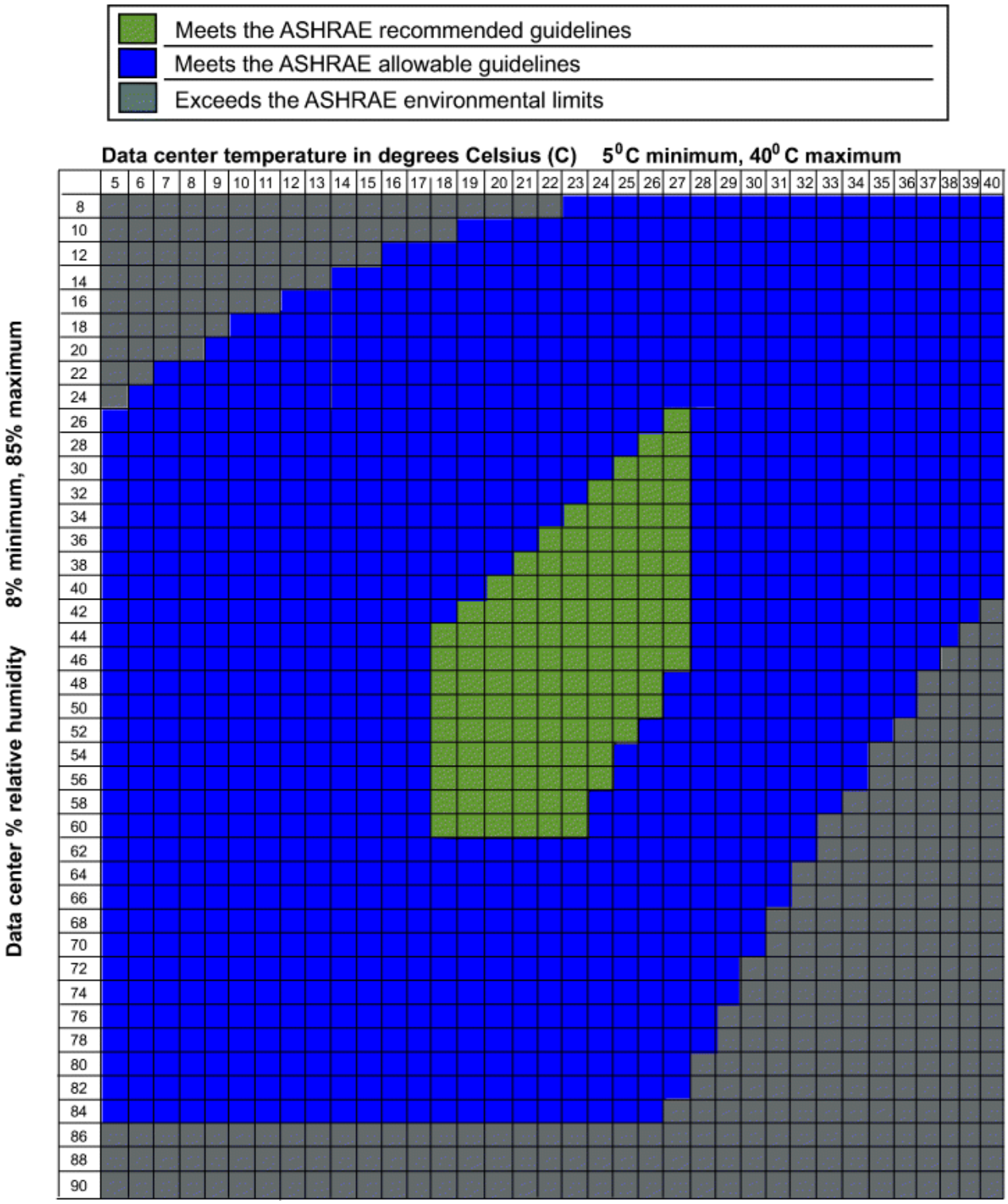


Figure 4. Environmental operating specifications - bar graph format

Notes:

1. Graph is shown in SI (metric) units and a barometric pressure 101.325 kPa (sea level).
2. The recommended operating environment specifies a long-term operating environment that can result in the greatest reliability and energy efficiency.

3. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation, for example in the case of a cooling failure.
4. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).
5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See “Acoustics” on page 23 for the declared acoustical noise emission levels for the system.
6. In the allowable operating environment, moisture levels lower than 0.5°C (32.9°F) dew point, but not lower than the low end moisture limit, can be accepted if appropriate control measures are implemented to limit the generation of static electricity on personnel and equipment in the data center. All personnel and mobile furnishings/equipment must be connected to the ground via an appropriate static control system. The following items are considered the minimum requirements:
   a. Conductive materials
      1) Conductive flooring
      2) Conductive footwear on all personnel that go into the data center, including visitors
      3) All mobile furnishings/equipment to be made of conductive or static dissipative materials
   b. During maintenance on any hardware, a properly functioning wrist strap must be used by personnel who contacts the system.

It is very important the environmental specifications be met immediately in front of both frames of the 3906. Ideally, it would be best if the temperature and humidity controls are good enough to surround the service area of the 3906.

Water cooling

The 3906 can be either radiator-cooled or water-cooled. The water cooled 3906 operates from two fully redundant water control units (WCUs). These WCU each have their own facility feed and return water connections. The facility water requirements for the 3906 meet the ASHRAE W2 Liquid Cooling Class, that is facility supply water temperatures up to 27°C (80.6°F).

The W2 class is the typical data center cooling infrastructure utilizing a chiller and a cooling tower. However, the upper end of the W2 class allows the data center to improve energy efficiency, depending on the location of the data center, by taking advantage of additional economizer hours.

The amount of heat removed to the facility water is dependent on several factors, including the temperature of the facility water, the data center air temperature, the data center dew point and the system configuration. Although at the warmest fluid temperatures and largest system configurations, the 3906 does not remove 100% of the heat to facility water, customers may find providing warmer building water more convenient and overall an energy saving despite a higher fraction of the server heat load retained in the exhaust air. See “Special cooling recommendations for water-cooled machine” on page 86 for additional details.

System acclimation

Server and storage equipment (racks and frames) should be gradually acclimated to the surrounding environment before being powered on.

When server and storage equipment is shipped in a climate where the outside temperature is below the dew point of the destination indoor location, condensation and frost will naturally form on the cooler inside and outside surfaces of the equipment when brought indoors. All IBM products are tested and verified to withstand these phenomena produced under these circumstances. As long as sufficient time is provided to allow the hardware to gradually acclimate to the indoor environment before attaching it to electrical power, there should be no issues with long term reliability of the product.

General recommendations

- DO NOT attach power to the product before the recommended acclimation time. Attaching power may cause some features to enter into a stand-by mode even before the product has been formally switched on.
- Product must be acclimated before attaching to power to avoid shorts and other damage due to wet or moist components. Use of vapor barrier bags and/or desiccant does not negate the need for acclimation.
- If the install/staging area environment allows it, DO leave the product in the full package, or at least the inner plastic bag, for the recommended time as shown in the following tables. This helps minimize condensation directly on or within the product.
- Acclimate the product away from perforated tiles or other direct sources of forced air convection to minimize excessive condensation on or within the equipment. DO NOT blow room air at the product to acclimate it faster as this can *increase* moisture accumulation within the product and may also cause dust from the room to adhere to moist surfaces.
- If possible, try to acclimate the system in environments where the temperature is greater than 15°C (59°F), the relative humidity is less than 60%, and the dewpoint is less than 27°C (80°F) to minimize the acclimation time. Cold, humid environments will lead to greater acclimation times.

Determining system acclimation time

Note: Use the following information to determine the system acclimation time, unless otherwise stated by product specific install instructions.

1. Determine the shipping condition and lowest temperature the product was exposed to in the 48 hours prior to it being moved to the staging area or final installation area. Work with your IBM representative if you don't have this information..
   - Use Table 3 on page 19 if the minimum temperature was between -40°C (-40°F) and -20°C (-4°F). Shipments conducted in cold weather or in cold climes and which were not conveyed in climate-controlled trucking will need to use this table.
   - Use Table 4 on page 19 if the minimum temperature was between -20°C (-4°F) and 0°C (32°F). Shipments conducted in cold weather or in cold climes and which were not conveyed in climate-controlled trucking will need to use this table.
   - Use Table 5 on page 19 if the minimum temperature was between 0°C (32°F) and 15°C (59°F). Shipments conducted in chilly to mild weather and which were not conveyed in climate-controlled trucking may use this table. Air shipments followed by transport in warmer conditions may also use this table. If air shipment was followed by non-climate controlled transport in very cold or cold conditions, then use Table 3 on page 19 and Table 4 on page 19, respectively.
   - Use Table 6 on page 20 if the minimum temperature was greater than 15°C (59°F). Shipments conducted in warm/hot weather or in climate controlled conditions may use this table. If shipments were transported by air less than 48 hours prior to delivery, this table may not be used. Refer to Table 3 on page 19, Table 4 on page 19, or Table 5 on page 19 instead.
2. Once the appropriate acclimation table has been identified, determine the acclimation zone (AA-D) for your environment. Determine the *minimum* temperature and *maximum* relative humidity of the room where the product will be acclimated. If the temperature falls between two tabulated values, use the *lower* tabulated temperature. If the relative humidity falls between two tabulated values, use the *higher* tabulated relative humidity.
3. Once the acclimation zone has been determined, use Table 7 on page 20 to determine the acclimation requirements for the system. For example, if the acclimation zone was determined to be C, then you will need to acclimate the system in its packaging (or bag) for 24 hours, then remove the packaging, and then acclimate for an additional 24 hours for a total of 48 hours.
4. Once the system has been acclimated as recommended, verify that both the outer surface of the frame and inner circuit boards/components of the system are free of moisture. A system may appear dry on the outside but may still be wet inside. If moisture is present, continue to acclimate the system without the packaging for an additional 12 hours before reverifying that it is dry. Continue acclimating

and reverifying in 12 hour intervals while moisture persists. If moisture is still found to be present after a week, please contact an IBM representative for assistance and to troubleshoot the environment in which the system is acclimating.

Table 3. Acclimation zone table for shipments conducted in non-climate controlled and extreme cold weather conditions (-40°C / -40°F to -20°C / -4°F)

extreme cold: -40° C (-40° F) to -20° C (-4° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	D	C	C	C	C	B	B	B	B
	20	D	C	C	C	C	C	B	B	B
	40	D	D	C	C	C	C	C	C	X
	60	D	D	D	C	C	C	C	X	X
	80	X	D	D	D	D	C	X	X	X
	85	X	X	D	D	D	D	X	X	X

Table 4. Acclimation zone table for shipments conducted in non-climate controlled and very cold weather conditions (-20°C / -4°F to 0°C / 32°F)

very cold: -20° C (-4° F) to 0° C (32° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	C	C	B	B	B	B	B	B	B
	20	C	C	B	B	B	B	B	B	B
	40	D	C	C	B	B	B	B	B	X
	60	D	C	C	C	C	C	B	X	X
	80	X	D	D	C	C	C	X	X	X
	85	X	X	D	D	C	C	X	X	X

Table 5. Acclimation zone table for shipments conducted in non-climate controlled and cool weather conditions (0°C / 32°F to 15°C / 59°F). Shipments via air may use this table if subsequent transport and storage was in warmer conditions.

cool: 0° C (32° F) to 15° C (59° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	C	C	B	B	B	B	B	B	B
	20	C	C	B	B	B	B	B	B	B
	40	D	C	C	B	B	B	B	B	X
	60	D	C	C	C	C	C	B	X	X
	80	X	D	D	C	C	C	X	X	X
	85	X	X	D	D	C	C	X	X	X

Table 6. Acclimation zone table for shipments conducted in non-climate controlled but warm weather conditions or for shipments conducted in climate controlled trucking (15°C / 59°F and above). Shipments conducted via air may not use this table.

warm: 15° C (59° F) and above		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	AA	AA	AA	AA	AA	AA	AA	AA	AA
	20	AA	AA	AA	AA	AA	AA	AA	AA	AA
	40	AA	AA	AA	AA	AA	AA	AA	A	X
	60	AA	AA	AA	A	A	A	A	X	X
	80	AA	A	A	C	B	B	X	X	X
	85	AA	A	A	C	C	C	X	X	X

Table 7. Acclimation recommendation

Zone	In bag + Out of bag	Total
AA	0 hours + 6 hours	6 hours
A	0 hours + 24 hours	24 hours
B	12 hours + 12 hours	24 hours
C	1 day + 1 day	2 days
D	2 days + 2 days	4 days
X	Acclimation not recommended in this zone. Contact an IBM representative for assistance.	

Conductive contamination

Semiconductors and sensitive electronics used in current Information Technology equipment have allowed for the manufacture of very high density electronic circuitry. While new technology allows for significant increases or capacity in a smaller physical space, it is susceptible to contamination, especially contamination particles that will conduct electricity. Since the early 1990s, it has been determined that data center environments may contain sources of conductive contamination. Contaminants include; carbon fibers, metallic debris such as aluminum, copper and steel filings from construction, and zinc whiskers from zinc-electroplated materials used in raised floor structures.

Although very small, and at times not easily seen without the visual aide of magnifying lenses, this type of contamination can have disastrous impact on equipment availability and reliability. Errors, component damage and equipment outages caused by conductive contamination can be difficult to diagnose. Failures may be at first attributed to other more common factors such as lightning events or electrical power quality or even just presumed to be defective parts.

The most common conductive contamination in raised-floor data centers is what is known as zinc whiskers. It is the most common because it is frequently found on the underside of certain types of access floor tiles. Typically, the wood core style floor tile has a flat steel bottom. The steel may be coated with zinc either by a hot dip galvanize process or by zinc electroplate. The zinc electroplate steel exhibits a phenomena which appears as whisker-like growths on the surface. These small particles of approximately 1-2 mm (.04-.08 in.) in length, can break away from the surface and get pulled into the cooling air stream. Eventually they my be ingested by the equipment air, settle on a circuit board and create a problem. If you suspect that you may have this type of problem, contact your IBM service representative.

Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the 3906 that is described in this document. Risks that are posed by the presence of excessive particulate

levels or concentrations of harmful gases include damage that might cause the 3906 to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate or gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the 3906, IBM may condition provision of repair or replacement of the 3906 or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 8. Contaminant descriptions

Contaminant	**Description**
Gaseous contamination	Severity level G1 as per ANSI/ISA 71.04-1985[1] which states that the reactivity rate of copper coupons shall be less than 300 Angstroms per month (Å/month, ~ 0.0039 µg/cm^2-hour weight gain).[2] In addition, the reactivity rate of silver coupons shall be less than 200 Å/month (~ 0.0035 µg/cm^2-hour weight gain).[3] The reactive monitoring of gaseous corrosivity should be conducted approximately 2 inches (5 cm) in front of the rack on the air inlet side at one-quarter and three-quarter frame height off the floor or where the air velocity is much higher.
Particulate contamination	Data centers must meet the cleanliness level of ISO 14644-1 class 8. For data centers without airside economizer, the ISO 14644-1 class 8 cleanliness might be met by the choice of the following filtration: • The room air may be continuously filtered with MERV 8 filters. Air entering a data center may be filtered with MERV 11 or preferably MERV 13 filters. • For data centers with airside economizers, the choice of filters to achieve ISO class 8 cleanliness depends on the specific conditions present at that data center. The deliquescent relative humidity of the particulate contamination should be more than 60% RH.[4] Data centers must be free of zinc whiskers.[5]

Note:

1. ANSI/ISA-71.04.1985. "Environmental conditions for process measurement and control systems: Airborne contaminants. Instrument Society of America, Research Triangle Park, NC, 1985.
2. The derivation of the equivalence between the rate of copper corrosion product thickness growth in Å/month and the rate of weight gain assumes that Cu_2S and Cu_2O grow in equal proportions.
3. The derivation of the equivalence between the rate of silver corrosion product thickness growth in Å/month and the rate of weight gain assumes that Ag_2S is the only corrosion product.
4. The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote corrosion and/or ion migration.
5. Surface debris is randomly collected from 10 areas of the data center on a 1.5-cm diameter disk of sticky electrically conductive tape on a metal stub. If examination of the sticky tape in a scanning electron microscope reveals no zinc whiskers, the data center is considered free of zinc whiskers.
6. If there is any question about potential corrosive gases or level of particulates, contact your IBM representative for assistance in monitoring the environment.

Beyond the specific information provided in this document, it is recommended that the customer's facility meet the general guidelines published in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers* (ASHRAE) *Handbook*.

Acoustics

This section provides acoustical noise declarations for typical and maximum configurations of the 3906 for both nominal environmental ambient temperatures and altitude of 25º C plus or minus 2º C (77º F plus or minus 3.6º F) at 457 m (1500 ft) and the hot room condition of 35º C (95º F) at 1000 m (3281 ft).

Acoustical noise emission levels

Table 9. Acoustical noise emissions for the 3906 radiator-cooled (air-cooled) machine [1, 2, 3]

Product configuration	Declared A-weighted sound power level L_{WAd} (B)		Declared A-weighted sound pressure level L_{pAm} (dB)	
	Operating	Idling	Operating	Idling
Typical Configuration: • M/T 3906 Model M02 or LM2 radiator-cooled machine • Two PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear standard (acoustical) covers	7.9 [4]	7.9 [4]	62	62
Typical Configuration: • M/T 3906 Model M02 radiator-cooled machine • Two PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear thin covers	8.4 [5]	8.4 [5]	65	65
Maximum Configuration: • M/T 3906 Model M05 or LM5 radiator-cooled machine • Five PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear standard (acoustical) covers	8.5	8.5	68	68
Maximum Configuration: • M/T 3906 Model M05 radiator-cooled machine • Five PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear thin covers	9.0 [6]	9.0 [6]	71	71
Maximum Configuration: • M/T 3906 Model M05 or LM5 radiator-cooled machine • Five PCIe I/O drawers installed • Operation based on an environment of 35 C, 1000 m • Front and rear standard (acoustical) covers	9.2 [6]	9.2 [6]	75	75

Table 9. Acoustical noise emissions for the 3906 radiator-cooled (air-cooled) machine [1, 2, 3] (continued)				
Product configuration	**Declared A-weighted sound power level L_{WAd} (B)**		**Declared A-weighted sound pressure level L_{pAm} (dB)**	
	Operating	**Idling**	**Operating**	**Idling**
Maximum Configuration: • M/T 3906 Model M05 or LM5 radiator-cooled machine • Five PCIe I/O drawers installed • Operation based on an environment of 35 C, 1000 m • Front and rear thin covers	9.8 [6]	9.8 [6]	79	79

Notes:

1. Declared level L_{WAd} is the upper-limit A-weighted sound power level; Declared level L_{pAm} is the mean A-weighted sound pressure level measured at the 1-meter bystander positions.
2. All measurements made in conformance with ISO 7779 and declared in conformance with ISO 9296.
3. **B** and **dB** are the abbreviations for **bels** and **decibels**, respectively. 1 B = 10 dB.
4. Meets IT Product Noise Limits for "Generally Attended Data Center"per Statskontoret Technical Standard 26:6.
5. Meets IT Product Noise Limits for "Generally Unattended Data Center" per Statskontoret Technical Standard 26:6.
6. **Notice:** Government regulations (such as those prescribed by OSHA or European Community Directives) may govern noise level exposure in the workplace and may apply to you and your server installation. This IBM system is available with an optional acoustical door feature that can help reduce the noise emitted from this system. The actual sound pressure levels in your installation depend upon a variety of factors, including the number of racks in the installation; the size, materials, and configuration of the room where you designate the racks to be installed; the noise levels from other equipment; the room ambient temperature, and employees' location in relation to the equipment. Further, compliance with such government regulations also depends upon a variety of additional factors, including the duration of employees' exposure and whether employees wear hearing protection. IBM recommends that you consult with qualified experts in this field to determine whether you are in compliance with the applicable regulations.

Table 10. Acoustical noise emissions for the 3906 water-cooled machine [1, 2, 3]				
Product configuration	**Declared A-weighted sound power level L_{WAd} (B)**		**Declared A-weighted sound pressure level L_{pAm} (dB)**	
	Operating	**Idling**	**Operating**	**Idling**
Typical Configuration: • M/T 3906 Model M02 or LM2 water-cooled machine • Two PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear standard (acoustical) covers	7.5 [4]	7.5 [4]	58	58
Maximum Configuration: • M/T 3906 Model M05 or LM5 water-cooled machine • Five PCIe I/O drawers installed • All air-moving devices at nominal speeds • Front and rear standard (acoustical) covers	7.7 [4]	7.7 [4]	61	61
Maximum Configuration: • M/T 3906 Model M05 or LM5 water-cooled machine • Five PCIe I/O drawers installed • Operation based on an environment of 35 C, 1000 m • Front and rear standard (acoustical) covers	8.7	8.7	71	71

Notes:

1. Declared level L_{WAd} is the upper-limit A-weighted sound power level. Declared level L_{pAm} is the mean A-weighted sound pressure level measured at the 1-meter bystander positions.
2. The declared data was obtained through a combination of measurements made in accordance with ISO 7779 and modeled results.
3. **B** and **dB** are the abbreviations for **bels** and **decibels**, respectively. 1 B = 10 dB.
4. Meets IT Product Noise Limits for "Generally Attended Data Center"per Statskontoret Technical Standard 26:6.

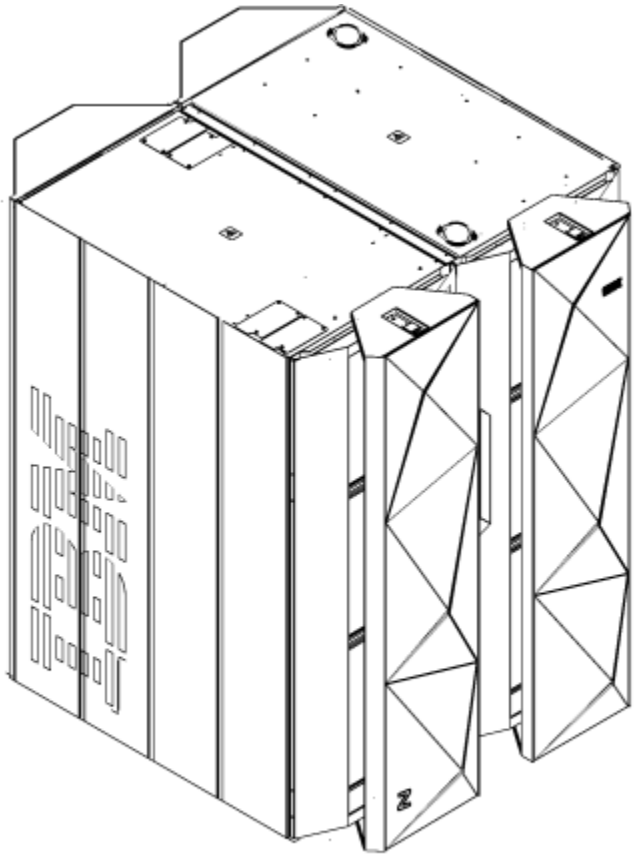
Relevant international standards

- Measurements: ISO 7779
- Declaration: ISO 9296

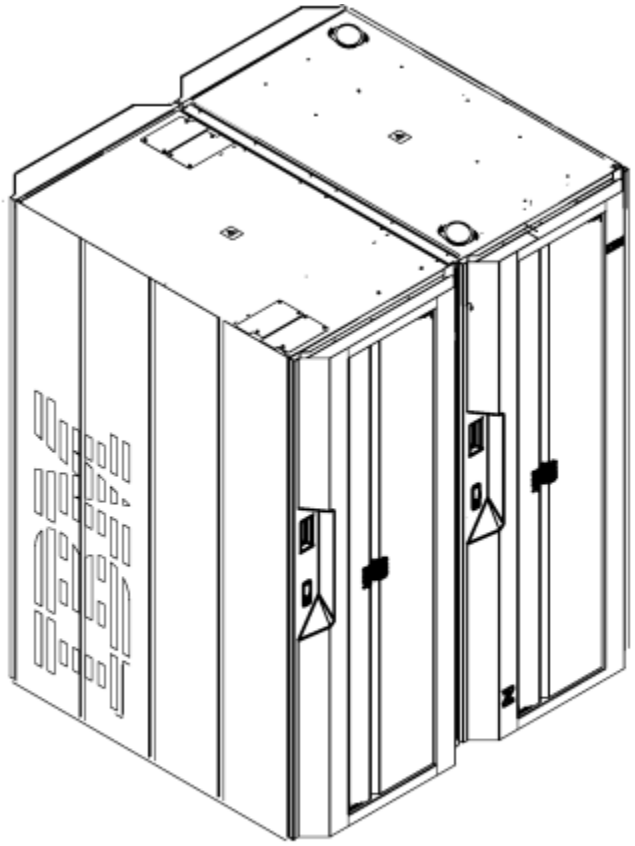
Chapter 3. Models and physical specifications

This chapter provides the following detailed information for the 3906.

- Model and frame descriptions
- Shipping specifications
- Plan view and specifications
- Weight distribution data
- Machine and service clearance areas
- Cooling recommendations.



3906 radiator-cooled and water-cooled models standard cover set - (FC 0160) - 323.0 mm (12.7 in) covers



z14 radiator-cooled models
thin cover set - (FC 0161) - 106.7 mm (4.2 in) covers

Facts you should know about the 3906:

- The 3906 is **always** a two-frame system
- The 3906 may have either two or four line cords, depending on the model you select. If you choose a server that requires only two power cords, but want to be prepared for future growth, you may order the Plan Ahead for Line Cord feature, FC 2000, which ships all four line cords regardless of the model.
- The 3906 can be powered from either an AC or DC source.
- The 3906 provides an overhead I/O cabling option (FC 7942). This consists of cable towers installed at all four corners of the server (two each on the A and Z frames). If selected, these towers and the side covers that go with them are shipped in separate containers.

  The 3906 provides overhead power cabling.
- The 3906 can be either radiator cooled or water cooled.

  The 3906 water-cooled models can only be installed on a raised floor. To accommodate the bend radius of the water hoses, the height of the raised floor (subfloor to top surface of floor tile) must be a minimum of 228.6 mm (9 inches).

  The 3906 radiator-cooled models can be installed on a raised floor or a nonraised floor.
- The following cover features can be installed:
  - On the 3906 radiator-cooled models and water-cooled models, the standard cover set feature (FC 0160) can be installed. FC 0160 consists of a 323.0 mm (12.7 in) front cover and a 266.76 (10.5 in) rear cover.
  - On the z14 radiator-cooled models, the thin cover set feature (FC 0161) can be installed. FC 0161 consists of a 106.7 mm (4.2 in) front cover and a 106.7 mm (4.2 in) rear cover.

- In a nonraised floor environment, where cables are exposed, refer to local and national electric and safety codes for more information.

  Note: If the 3906 is installed on a nonraised floor, the top exit I/O option (FC 7942) and the top exit power must be used.

- The frames are shipped as separate units, fastened together at install time.

  Important:
  The 3906, fully configured, can weigh in excess of 2903.45 kg (6401 lb). **Be certain that the raised floor on which you are going to install the server is capable of supporting this weight.**

  DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

- Feature codes 8003 and 8004 provide frame-stiffening and tie-down hardware for various height raised floors. Feature code 8005 provides frame-stiffening and tie-down hardware for nonraised floors. See “Frame-stiffening and tie-down -- Earthquake kit” on page 64 for more information.
- There are separate shipping containers for the covers for each frame.
- **If you are planning an installation on a raised floor in Canada**, the installation must be in accordance with Section 12-020 of the CPC. In any country, refer to your national electric code if you have questions about routing data processing cables in exposed areas.

Important: When an incline or ramp needs to be traversed during system transport, the angle of inclination must be less or equal to 10° degrees. Angles that are greater than 10° degrees, pose a safety hazard as well as expose the potential for the system rack to bottom out while transitioning to or from the level surface.

Physical dimensions

Note: For all combinations, if the top exit I/O cabling towers (FC 7942) are installed, **each** frame is 152.4 mm (6 in) wider. See "Plan views" on page 48 for a visual reference.

A and Z frame/cover combination	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Frames w/covers (radiator-cooled) without I/O cable towers	1567.2 (61.7)	1860.0 (73.2)[1] 1486.0 (58.5)[2]	2015 (79.3)	2713.8 (5983)[1]
Frames w/covers (radiator-cooled) with I/O cable towers	1846.6 (72.7)	1860.0 (73.2)[1] 1486.0 (58.5)[2]	2155 (84.8)[3]	2784.6 (6139)[1]
Frames w/covers (water-cooled) without I/O cable towers	1567.2 (61.7)	1964.0 (77.3)[1]	2015 (79.3)	2731.1 (6021)[1]
Frames w/covers (water-cooled) with I/O cable towers	1846.6 (72.7)	1964.0 (77.3)[1]	2155 (84.8)[3]	2801.9 (6177)[1]

Note:

1. Includes the installed standard front cover 323.0 mm (12.7 in) and standard rear 266.7 (10.5 in) cover.
2. For z14 radiator-cooled models, includes the installed thin front cover 106.7 (4.2 in) and thin rear cover 106.7 (4.2 in).
3. If the top exit I/O cable towers are installed and the optional cable management brackets are used, the overall system height will increase to 2155 mm (84.8 in). See "Top exit I/O cabling" on page 135 for details.

Shipping specifications

The 3906 is shipped in an Arbo box and wrapped in a vapor barrier bag containing desiccant packages in the bottom rear of the vapor barrier bag.

Important:

The 3906 is comprised of some of the most sophisticated and complex electronic equipment ever integrated into one computer. As such, this hardware needs to be protected from negative environmental impacts to ensure the utmost reliability. One of the key factors affecting this reliability is moving the system from the loading dock into the controlled environment of your computer room on the day it is delivered.

To ensure that optimum environmental conditions are maintained, work with your marketing representative to schedule the delivery at a time when you can transport the system components from the point of delivery to the computer room destination without unnecessary delay. Prompt handling upon arrival will prevent any possibility of a problem caused by exposure to temperature extremes, severe weather, or high humidity.

Dimensions

Crated frames	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Crated frame A (radiator-cooled)	939.8 (37.0)	1613.0 (63.5)	2299.0 (90.5)	1487 (3278)
Crated frame A (water-cooled)	939.8 (37.0)	1717.0 (68.0)	2299.0 (90.5)	1456 (3209)
Crated frame Z (radiator-cooled)	939.8 (37.0)	1613.0 (63.5)	2299.0 (90.5)	1490 (3285)
Crated frame Z (water-cooled)	939.8 (37.0)	1717.0 (68.0)	2299.0 (90.5)	1544 (3404)

Cover set (front and rear covers)	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Standard cover set (FC 0160) for radiator-cooled models and water-cooled models				
Frame A	1067.0 (42.0)	2172.0 (85.5)	1168.0 (46.0)	51.7 (114)
Frame Z	1067.0 (42.0)	2172.0 (85.5)	1168.0 (46.0)	51.7 (114)
Thin cover set (FC 0161) for z14 radiator-cooled models				
Frame A	863.6 (34.0)	2172.0 (85.5)	1092.2 (43.0)	27.2 (60)
Frame Z	863.6 (34.0)	2172.0 (85.5)	1092.2 (43.0)	27.2 (60)

Top exit I/O towers (FC 7942)	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Frame A (two top exit I/O towers per pack)	762.0 (30.0)	2184.4 (86.0)	431.8 (17.0)	75.8 (167.0)
Frame Z (two top exit I/O towers per pack)	762.0 (30.0)	2184.4 (86.0)	431.8 (17.0)	75.8 (167.0)

Height reduction - FC 9975

If you have doorways with openings less than 2032.0 mm (80.0 in) high, you should order feature code 9975. This feature reduces the frame height to 1808.5 mm (71.2 in). The top portion of the frames are shipped in a separate carton, as are the frame side covers.

Internal battery - FC 3216

If you ordered feature code 3216, the batteries for the A frame are shipped in the A frame. The batteries for the Z frame are shipped in their own packaging. The batteries must always be installed along with the server. If you ordered feature code 3216, the weight of the shipped A frame increases by 104.4 kg (230 lb).

3906 models

There are five z14 (machine type 3906) models: M01, M02, M03, M04, and M05 and five Emperor II (machine type 3906) models: LM1, LM2, LM3, LM4, and LM5. Each model contains user-definable Processor Units (PUs), System Assist Processors (SAPs), and spare PUs (used to provide uninterrupted computing if there should be a problem with a working PU).

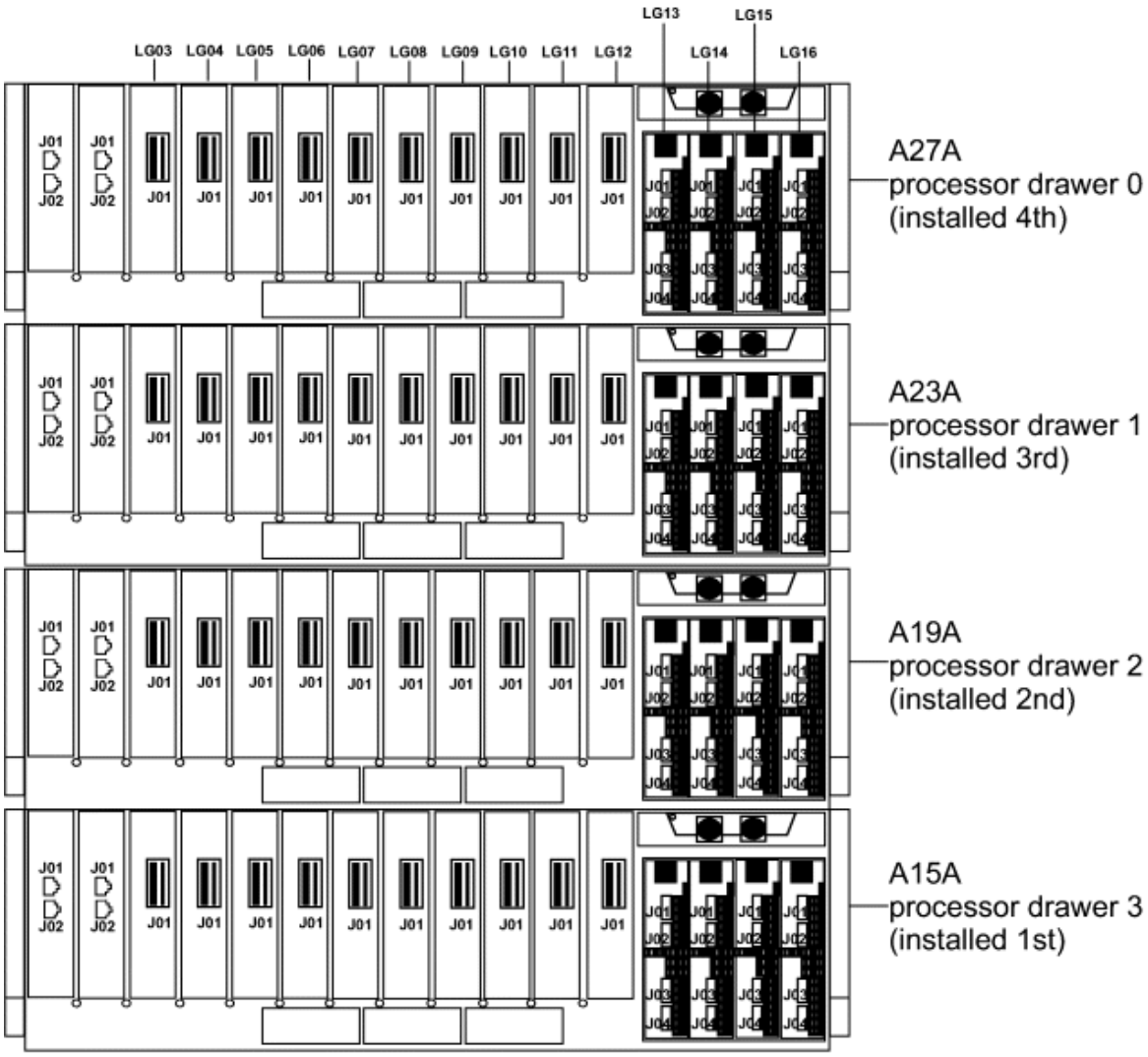
The following table lists the feature codes for each model. You will use the feature codes to place your 3906 order.

Table 11. Processor descriptions

3906 feature codes	Description
1023/1107	Model M01/Model LM1, radiator-cooled, 1 processor drawer
1024/1108	Model M02/Model LM2, radiator-cooled, 2 processor drawers
1025/1109	Model M03/Model LM3, radiator-cooled, 3 processor drawers
1026/1110	Model M04/Model LM4, radiator-cooled, 4 processor drawers
1027/1111	Model M05/Model LM5, radiator-cooled, 4 processor drawers
1028/1112	Model M01/Model LM1, water-cooled, 1 processor drawer
1029/1113	Model M02/Model LM2, water-cooled, 2 processor drawers
1030/1114	Model M03/Model LM3, water-cooled, 3 processor drawers
1031/1115	Model M04/Model LM4, water-cooled, 4 processor drawers
1032/1116	Model M05/Model LM5, water-cooled, 4 processor drawers

Model specifications are described in Table 12 on page 35 and Table 13 on page 38.

Note: PCIe copper (PCIe Interconnect) cables are used to connect PCIe I/O drawers to the processor.


LG03
LG04
LG05
LG06
LG07
LG08
LG09
LG10
LG11
LG12
LG13
LG14
LG15
LG16
A27A
processor drawer 0
(installed 4th)
A23A
processor drawer 1
(installed 3rd)
A19A
processor drawer 2
(installed 2nd)
A15A
processor drawer 3
(installed 1st)

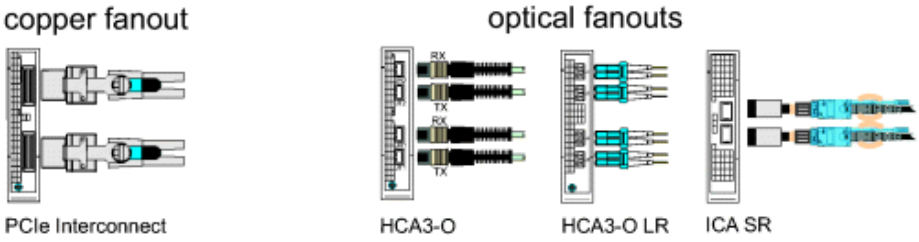

copper fanout
optical fanouts
PCIe Interconnect
HCA3-O
HCA3-O LR
ICA SR

Table 12. 3906 models M01, M02, M03, M04, and M05 feature codes and options

Feature codes	Options
Model M01 **FC 1023 (radiator-cooled)** **FC 1028 (water-cooled)**	• 1 processor drawer • 0 - 33 CPs • 0 - 33 IFLs • 0 - 32 uIFLs • 0 - 33 ICFs • 0 - 22 zIIPs • 1 - IFP • 5 - base SAPs • 0 - 4 optional SAPs • 2 - spares • I/O links: – 0 - 4 Infiniband features (combination of HCA3-O and HCA3-O LR) - HCA3-O 12x (2 links per feature) - HCA3-O LR 1x (4 links per feature) – 0 - 20 ICA SR links (10 features)
Model M02 **FC 1024 (radiator-cooled)** **FC 1029 (water-cooled)**	• 2 processor drawers • 0 - 69 CPs • 0 - 69 IFLs • 0 - 68 uIFLs • 0 - 69 ICFs • 0 - 46 zIIPs • 1 - IFP • 10 - base SAPs • 0 - 8 optional SAPs • 2 - spares • I/O links: – 0 - 8 Infiniband features (combination of HCA3-O and HCA3-O LR) - HCA3-O 12x (2 links per feature) - HCA3-O LR 1x (4 links per feature) – 0 - 40 ICA SR links (20 features)

Table 12. 3906 models M01, M02, M03, M04, and M05 feature codes and options (continued)

Feature codes	Options
Model M03 **FC 1025 (radiator-cooled)** **FC 1030 (water-cooled)**	• 3 processor drawers • 0 - 105 CPs • 0 - 105 IFLs • 0 - 104 uIFLs • 0 - 105 ICFs • 0 - 70 zIIPs • 1 - IFP • 15 - base SAPs • 0 - 12 optional SAPs • 2 - spares • I/O links: – 0 - 12 Infiniband features (combination of HCA3-O and HCA3-O LR) - HCA3-O 12x (2 links per feature) - HCA3-O LR 1x (4 links per feature) – 0 - 60 ICA SR links (30 features)
Model M04 **FC 1026 (radiator-cooled)** **FC 1031 (water-cooled)**	• 4 processor drawers • 0 - 141 CPs • 0 - 141 IFLs • 0 - 140 uIFLs • 0 - 141 ICFs • 0 - 94 zIIPs • 1 - IFP • 20 - base SAPs • 0 - 16 optional SAPs • 2 - spares • I/O links: – 0 - 16 Infiniband features (combination of HCA3-O and HCA3-O LR) - HCA3-O 12x (2 links per feature) - HCA3-O LR 1x (4 links per feature) – 0 - 80 ICA SR links (40 features)

Table 12. 3906 models M01, M02, M03, M04, and M05 feature codes and options (continued)

Feature codes	Options
Model M05 **FC 1027 (radiator-cooled)** **FC 1032 (water-cooled)**	• 4 processor drawers • 0 - 170 CPs • 0 - 170 IFLs • 0 - 169 uIFLs • 0 - 170 ICFs • 0 - 112 zIIPs • 1 - IFP • 23 - base SAPs • 0 - 16 optional SAPs • 2 - spares • I/O links: – 0 - 16 Infiniband features (combination of HCA3-O and HCA3-O LR) - HCA3-O 12x (2 links per feature) - HCA3-O LR 1x (4 links per feature) – 0 - 80 ICA SR links (40 features)
Internal Battery Feature **FC 3216**	• Available in all models • Up to three pairs of batteries are provided, depending on system power configuration
Terminology: • CP - Central Processor • IFL - Integrated Facility for Linux® • ICF - Integrated Coupling Facility • SAP - System Assist Processor • zIIP - IBM Integrated Information Processor • IFP - Integrated Firmware Processor	

Table 13. 3906 models LM1, LM2, LM3, LM4, and LM5 feature codes and options	
Feature codes	**Options**
Model LM1 **FC 1107 (radiator-cooled)** **FC 1112 (water-cooled)**	• 1 processor drawer • 0 - 1 CP • 0 - 33 IFLs • 0 - 32 uIFLs • 0 ICFs • 0 zIIPs • 1 - IFP • 5 - base SAPs • 0 - 4 optional SAPs • 2 - spares • I/O links: – 0 - 20 ICA SR links (10 features)
Model LM2 **FC 1108 (radiator-cooled)** **FC 1113 (water-cooled)**	• 2 processor drawers • 0 - 1 CP • 0 - 69 IFLs • 0 - 68 uIFLs • 0 ICFs • 0 zIIPs • 1 - IFP • 10 - base SAPs • 0 - 8 optional SAPs • 2 - spares • I/O links: – 0 - 40 ICA SR links (20 features)
Model LM3 **FC 1109 (radiator-cooled)** **FC 1114 (water-cooled)**	• 3 processor drawers • 0 - 1 CP • 0 - 105 IFLs • 0 - 104 uIFLs • 0 ICFs • 0 zIIPs • 1 - IFP • 15 - base SAPs • 0 - 12 optional SAPs • 2 - spares • I/O connectors: – 0 - 60 ICA SR links (30 features)

Table 13. 3906 models LM1, LM2, LM3, LM4, and LM5 feature codes and options (continued)

Feature codes	Options
Model LM4 **FC 1110 (radiator-cooled)** **FC 1115 (water-cooled)**	• 4 processor drawers • 0 - 1 CP • 0 - 141 IFLs • 0 - 140 uIFLs • 0 ICFs • 0 zIIPs • 1 - IFP • 20 - base SAPs • 0 - 16 optional SAPs • 2 - spares • I/O connectors: – 0 - 80 ICA SR links (40 features)
Model LM5 **FC 1111 (radiator-cooled)** **FC 1116 (water-cooled)**	• 4 processor drawers • 0 - 1 CP • 0 - 170 IFLs • 0 - 169 uIFLs • 0 ICFs • 0 zIIPs • 1 - IFP • 23 - base SAPs • 0 - 16 optional SAPs • 2 - spares • I/O connectors: – 0 - 80 ICA SR links (140 features)
Internal Battery Feature **FC 3216**	• Available in all models • Up to three pairs of batteries are provided, depending on system power configuration
Terminology: • CP - Central Processor • IFL - Integrated Facility for Linux • ICF - Integrated Coupling Facility • SAP - System Assist Processor • zIIP - IBM Integrated Information Processor • IFP - Integrated Firmware Processor	

Additionally, as shown in Figure 5 on page 40, Figure 6 on page 41, Figure 7 on page 42, and Figure 8 on page 43:

- The processor drawers are located below the system control hub (SCH) position in the A frame.
- The processor cooling components are located at the bottom of the A frame.

- The system power supply is contained in the top of the Z frame, below the battery positions.
- Input/Output features are installed in the PCIe I/O drawers in the following locations:
  - A PCIe I/O drawer can be installed in the space above the processor drawers in the A frame
  - PCIe I/O drawers can be installed in the area below the bulk power supply in the Z frame.

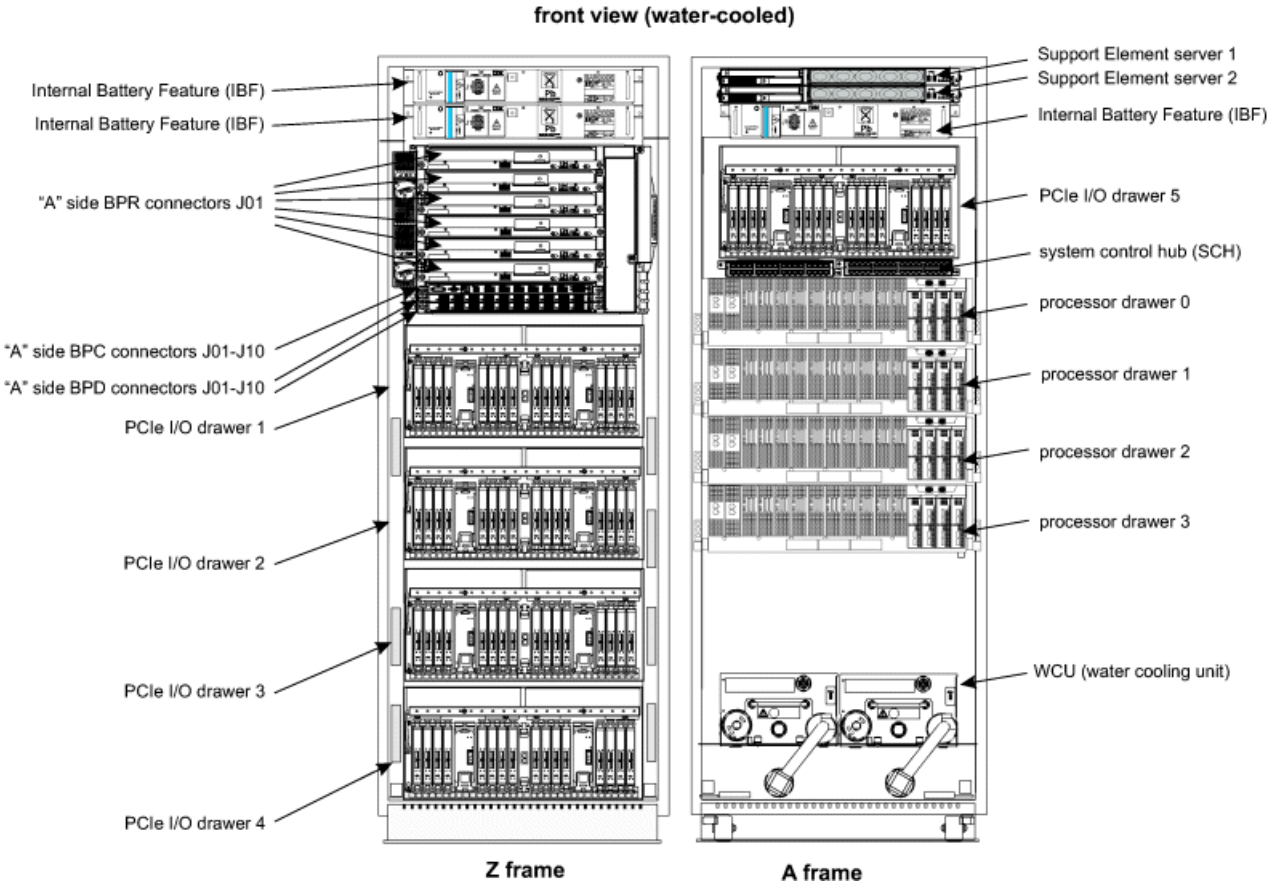


Figure 5. 3906 - front view - water-cooled

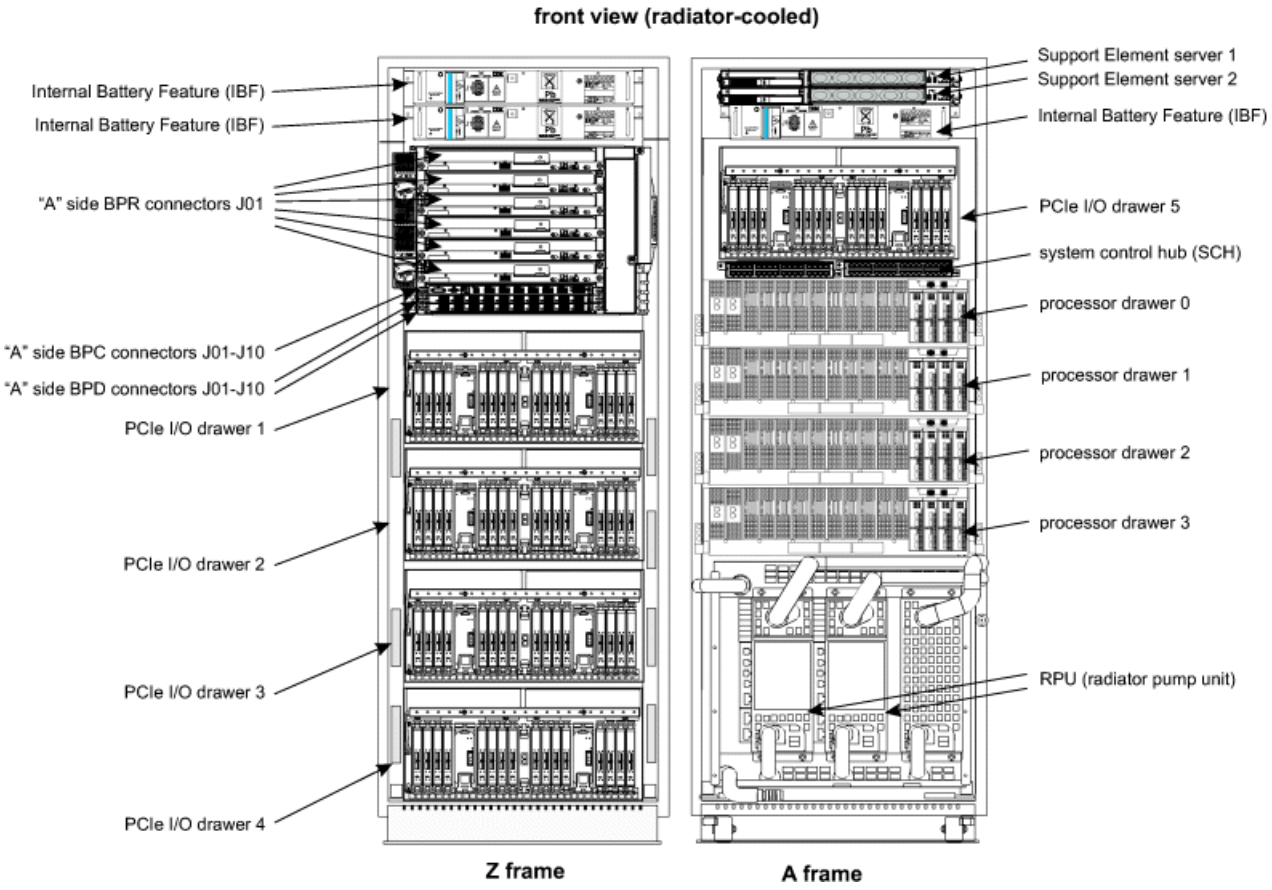


Figure 6. 3906 - front view - radiator-cooled

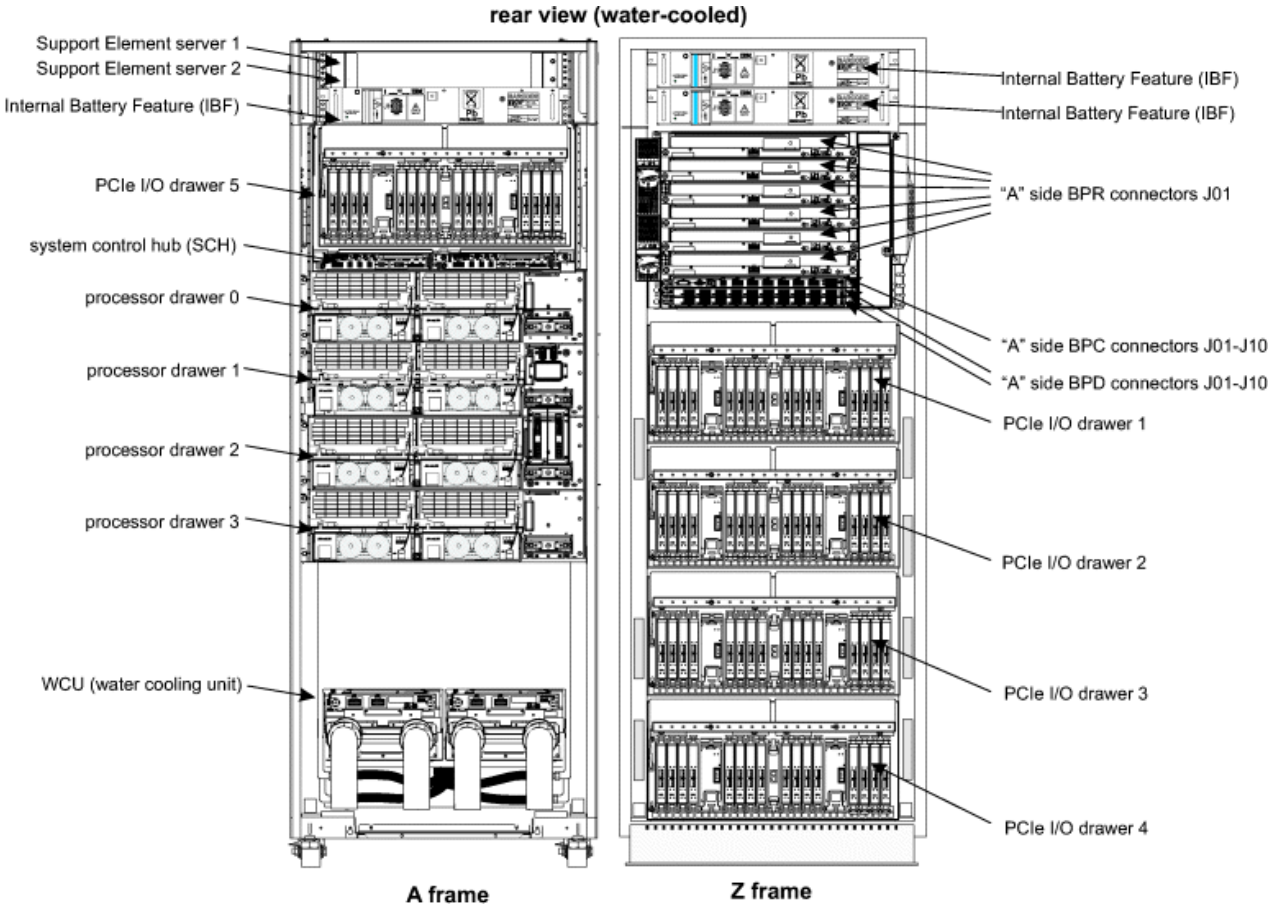


Figure 7. 3906 - rear view - water-cooled

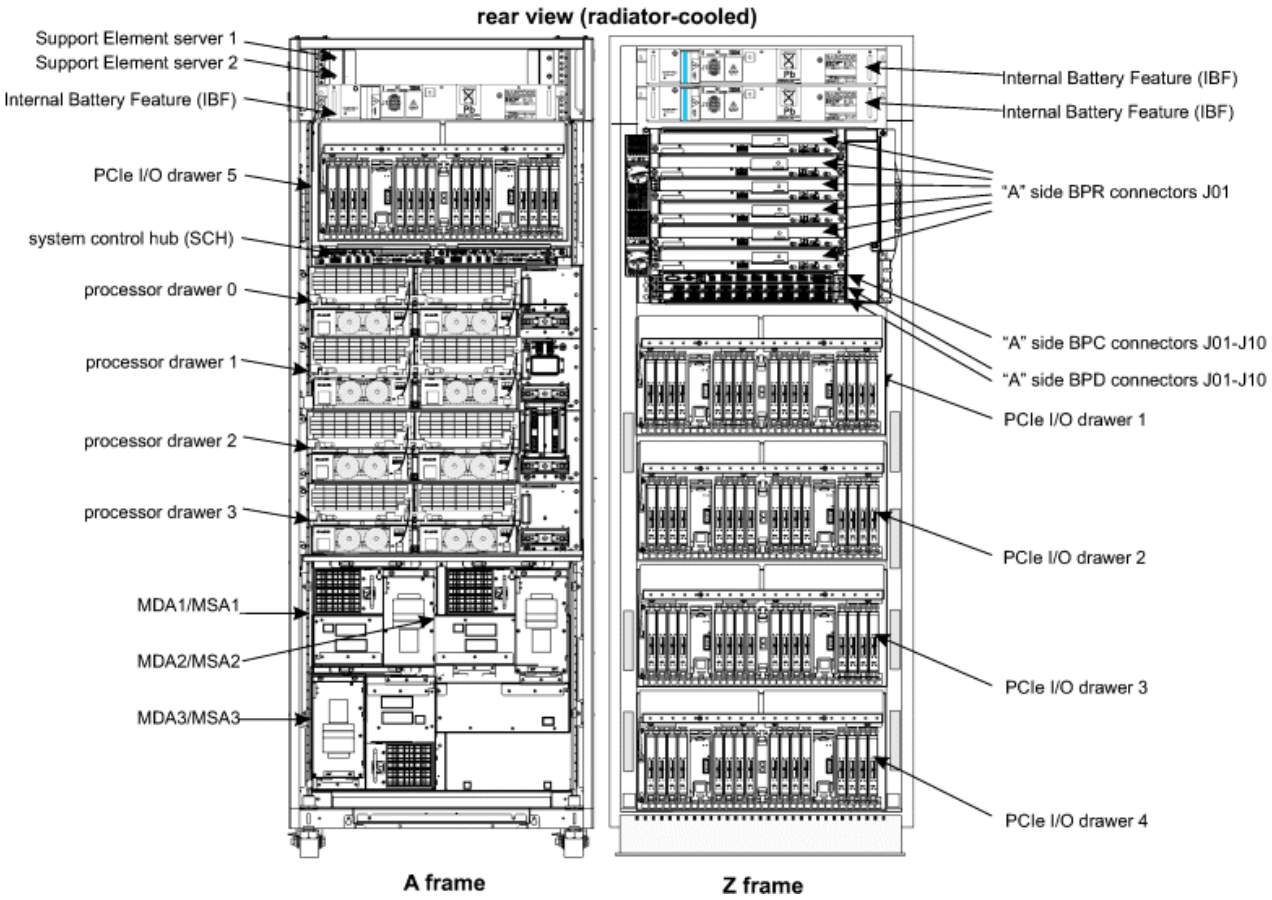
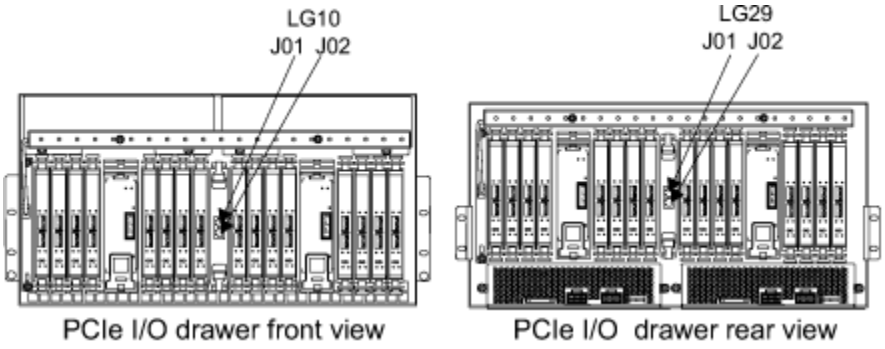


Figure 8. 3906 - rear view - radiator-cooled

PCIe I/O drawers

The 3906 supports PCIe I/O drawers.

- PCIe I/O drawer - 7 EIA units tall - provides 32 adapters, with two ports per adapter.



PCIe I/O drawer front view

PCIe I/O drawer rear view

System upgrades

- The following upgrades **are** supported:
  - 2827 (zEC12) or 2964 (z13®) radiator-cooled model to a 3906 (z14) radiator-cooled or water-cooled model
  - 2827 (zEC12) or 2964 (z13) water-cooled model to a 3906 (z14) water-cooled model
  - 3906 (z14) radiator-cooled to a 3906 (z14) radiator-cooled upgrades:
    - M01 --> M02, M03, M04
    - M02 --> M03, M04
    - M03 --> M04
  - 3906 (z14) radiator-cooled or water-cooled to a 3906 (z14) water-cooled upgrades:
    - M01 --> M02, M03, M04
    - M02 --> M03, M04
    - M03 --> M04
  - Emperor radiator-cooled model to a 3906 (z14) or Emperor radiator-cooled upgrades:
    - LM1 --> LM2, LM3, LM4, M01, M02, M03, M04
    - LM2 --> LM3, LM4, M02, M03, M04
    - LM3 --> LM4, M03, M04
    - LM4 --> M04
  - Emperor water-cooled model to a 3906 (z14) or Emperor water-cooled model upgrades:
    - LM1 --> LM2, LM3, LM4, M01, M02, M03, M04
    - LM2 --> LM3, LM4, M02, M03, M04
    - LM3 --> LM4, M03, M04
    - LM4 --> M04
- The following upgrades **are not** supported:
  - 2827 (zEC12) or 2964 (z13) water-cooled model to any 3906 (z14) radiator-cooled model
  - 2827 (zEC12), 2964 (z13), or 3906 (z14) to any Emperor model
  - Any Emperor water-cooled model to any 3906 (z14) or Emperor radiator-cooled model
  - Any Emperor radiator-cooled model to any 3906 (z14) or Emperor water-cooled model

An upgrade includes all frames, drawers, support cards, and new I/O features.

Differences between IBM servers

Although you can only upgrade to a z14 from a z13, or zEC12, or Emperor, minimum comparison information is provided here for those who may be placing a z14 or Emperor II on a raised floor with G5/G6, z900, z990, z9® EC, or z10 EC, z196, or zEC12 servers.

Table 14. Differences between single-frame servers

System family	Depth (with covers)	Height (with covers)	Weight (Maximum)
Generation 5/6 (9672)	1143 mm (45 in) or 1447 mm (57 in)	1785 mm (70.3 in) or 2026 mm (79.75 in)	1502 kg (3312 lb)
z900 (2064)	1666 mm (65.6 in)	2026 mm (79.8 in)	1866 kg (4114 lb)
z990 (2084)	1577 mm (62.1 in)	1941 mm (76.4 in)	2008 kg (4427 lb)
z9 EC (2094)	1577 mm (62.1 in)	1941 mm (76.4 in)	2003 kg (4415 lb)
z10 EC (2097)	1806 mm (71.1 in)	2027 mm (79.8 in)	2318 kg (5110 lb)
z196 (2817) (air-cooled)	1806 mm (71.1 in)	2027 mm (79.8 in)	2621 kg (5791 lb)
z196 (2817) (water-cooled)	1908 mm (75.1 in)	2027 mm (79.8 in)	2654 kg (5853 lb)
zEC12 (2827) (radiator-cooled)	1869 mm (73.6 in)	2014.3 mm (79.3 in)	2608 kg (5751 lb)
zEC12 (2827) (water-cooled)	1971 mm (77.6 in)	2014.3 mm (79.3 in)	2673 kg (5895 lb)
z13 or Emperor (2964) (radiator-cooled)	1869.5 mm (73.6 in)	2014.3 mm (79.3 in)	2784.6 kg (6139 lb)
z13 or Emperor (2964) (water-cooled)	1971.1 mm (77.6 in)	2014.3 mm (79.3 in)	2801.9 kg (6177 lb)
z14 or Emperor II (3906) (radiator-cooled)	1860.0 mm (73.2 in) [1] 1486.0 mm (58.5 in) [2]	2014.3 mm (79.3 in)	2784.6 kg (6139 lb) [1] 2735.6 kg (6031 lb) [2]
z14 or Emperor II (3906) (water-cooled)	1964.0 mm (77.3 in)	2014.3 mm (79.3 in)	2801.9 kg (6177 lb) [1]

Note:

1. Includes the installed standard cover set.
2. For z14 radiator-cooled machines, includes the installed thin cover set.
3. This weight does not include the weight (54.43 kg (120 lb)) for the tie-down feature (FC 8003, FC 8004, or FC 8005).
4. All server frames are the same width, approximately 784.9 mm (30.9 in) with the side covers installed.
5. Each 3906 frame, with the optional I/O cabling top exit feature (FC 7942), are 937.3 mm (36.9 in) wide.
6. The z14, Emperor II, z13, z196, z10 EC, z9 EC, and z990 always consist of two frames. G5/G6 and z900 servers may be either one or two frames, depending on configuration. z900 servers may also have a third frame for Internal Battery Features.
7. Major differences in power and processor packaging, cooling, and I/O exist between z14, Emperor II, z13, Emperor, zEC12, z196, z10 EC, z9 EC, z990, z900, and G5/G6 servers.

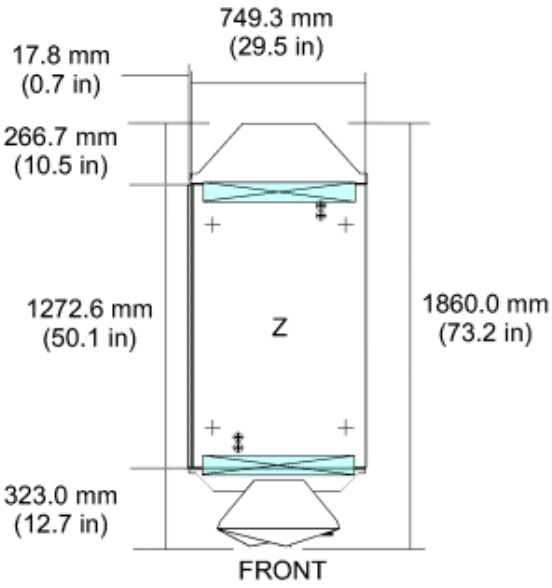
If you are replacing an existing IBM server, carefully read the *Installation Manual for Physical Planning* (available on the Resource Link web site) to determine actual differences between your installed IBM server and the z14 or Emperor II. Plan views, physical dimensions, service clearances, aisle spacing, and power and cooling requirements may be substantially different.

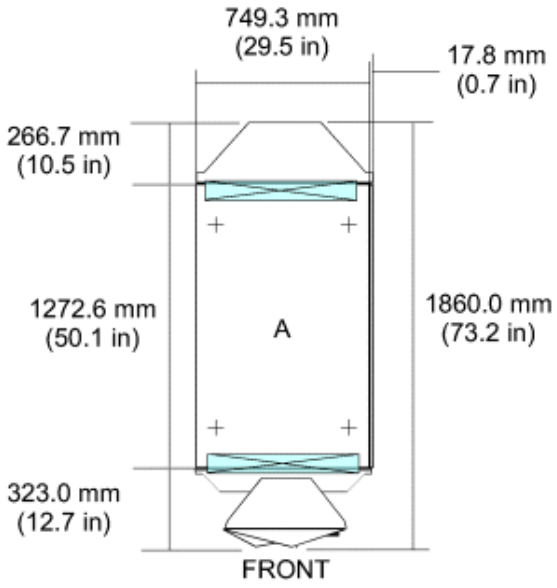
Plan views

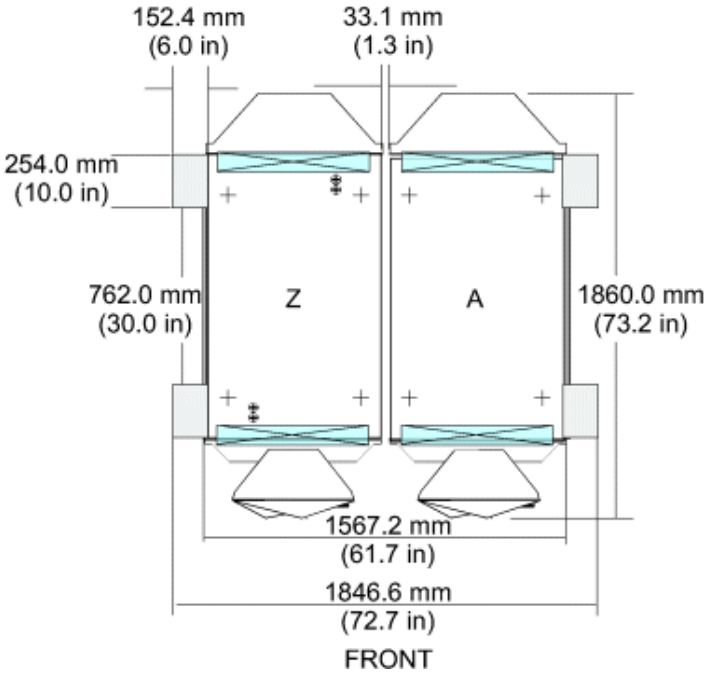
Note: In the following plan views, the I/O top exit towers (FC 7942) are shown as gray boxes at the outer corners of the A and Z frames in the bottom drawing. This is an **optional** feature.

Note: For installations planning to use top exit power cords, the frame openings for these cords are on the top of the left front and right rear corners of the Z frame.

radiator cooling - with 323.0 mm (12.7 in) cover

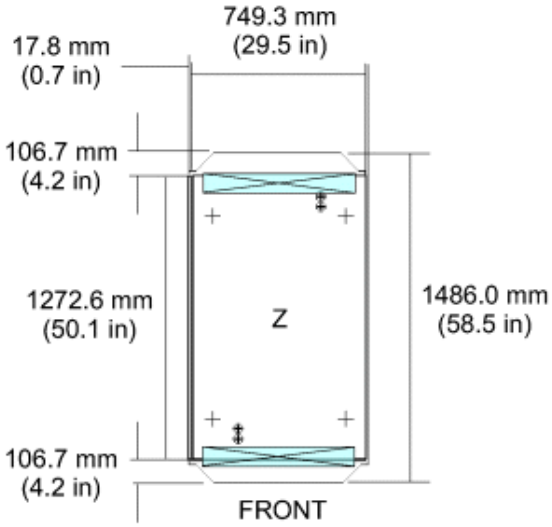


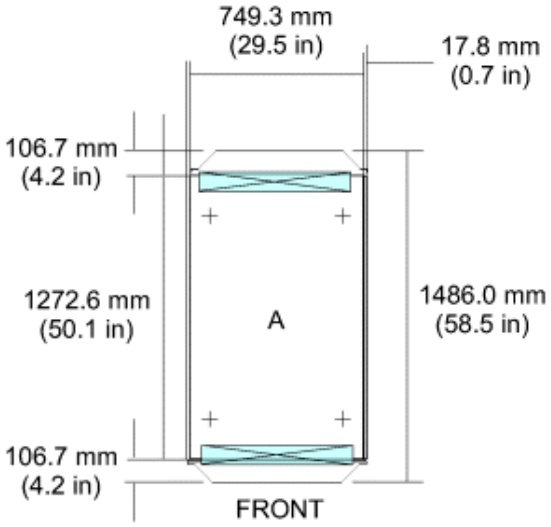


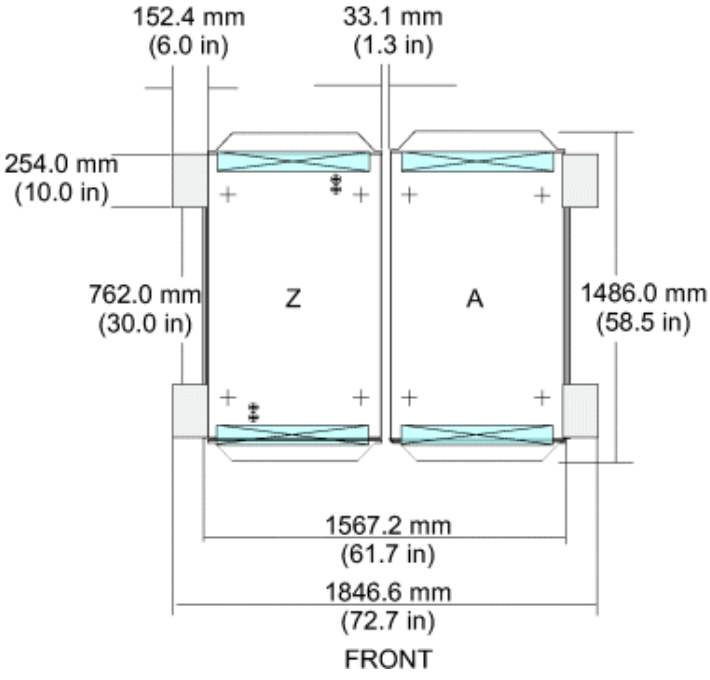


Frame Entry/Exit	Cutout dimensions for raised floor	
	(mm)	(in)
Front Rear	94.0 x 655.4 94.0 x 655.4	3.7 x 25.8 3.7 x 25.8

z14 radiator cooling - with 106.7 mm (4.2 in) cover

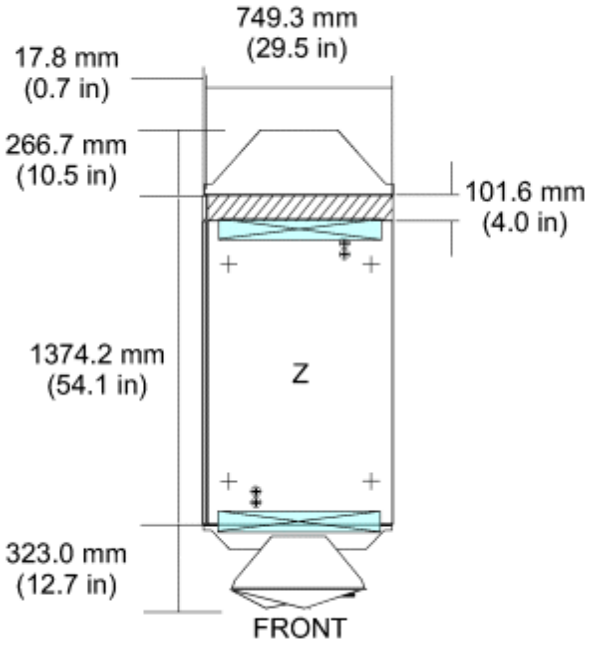


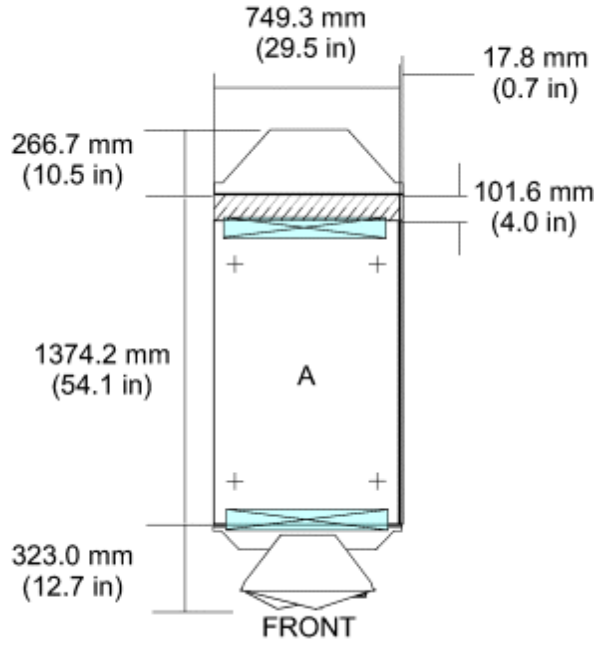


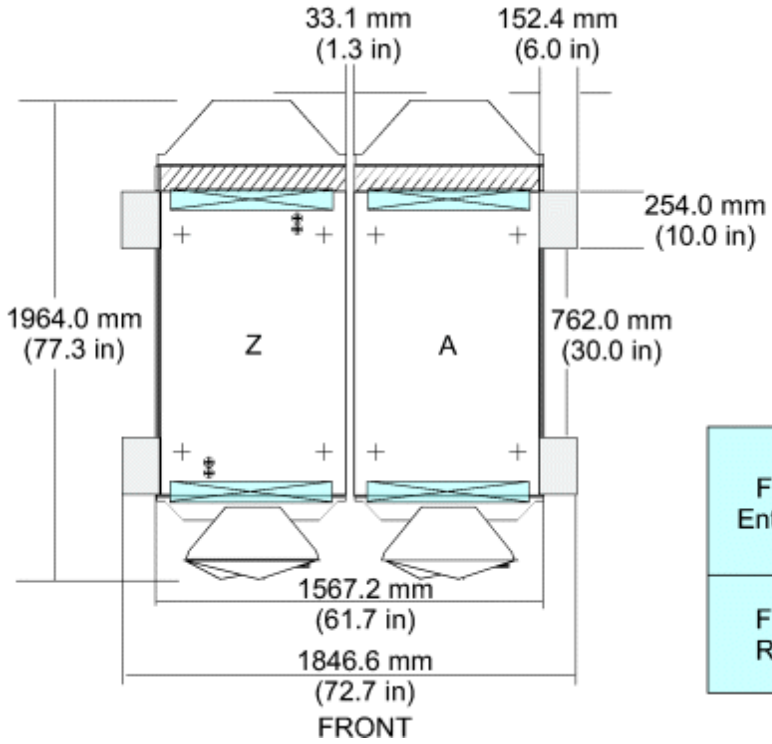


Frame Entry/Exit	Cutout dimensions for raised floor	
	(mm)	(in)
Front Rear	94.0 x 655.4 94.0 x 655.4	3.7 x 25.8 3.7 x 25.8

chilled water cooling







Frame Entry/Exit	Cutout dimensions for raised floor	
	(mm)	(in)
Front Rear	94.0 x 655.4 94.0 x 655.4	3.7 x 25.8 3.7 x 25.8

Weight distribution and structural integrity

The following table shows weights and dimensions used to calculate floor loading for the 3906. All floor loading calculations are intended for a raised floor environment. If you are using a nonraised floor environment, these floor loading calculations do not apply.

Table 15. Maximum weights with the Internal Battery Feature (IBF)

Maximum	A and Z frames with Internal Battery Feature (3216) (Model M05 or LM5)
Radiator-cooled	
Weight [1, 4]	2836 kg (6252 lb) [2] 2787 kg (6144 lb) [3]
Width [1, 5]	1567.2 mm (61.7 in)
Depth [1]	1272.6 mm (50.1 in)
Water-cooled	
Weight [1, 4]	2883 kg (6356 lb)
Width [1, 5]	1567.2 mm (61.7 in)
Depth [1]	1374.2 mm (54.1 in)

Table 16. Maximum weights without the Internal Battery Feature (IBF)

Maximum	A and Z frames without Internal Battery Feature (3216) (Model M05 or LM5)
Radiator-cooled	
Weight [1, 4]	2532 kg (5581 lb) [2] 2483 kg (5473 lb) [3]
Width [1, 5]	1567.2 mm (61.7 in)
Depth [1]	1272.6 mm (50.1 in)
Water-cooled	
Weight [1, 4]	2579 kg (5685 lb)
Width [1, 5]	1567.2 mm (61.7 in)
Depth [1]	1374.2 mm (54.1 in)

Notes:

1. Weight includes covers, I/O towers, earthquake feature, and water. Weight decreases by 81.7 kg (180 lb) if the earthquake feature is not installed. Weight decreases by 70.8 kg (156 lb) if the top exit I/O feature is not installed. Width and depth are indicated without covers.
2. Includes the weight for the standard cover set.
3. For z14 radiator-cooled models, includes the weight for the thin cover set.
4. For two-frame systems, weight is based on maximum system configuration, not the addition of the maximum weight of each frame.
5. Width increases to 1846.6 mm (72.7 in) if the top exit I/O feature (FC 7942) is installed.

The following figure and tables show sample floor loading values for the 3906, with and without the Internal Battery Feature (FC 3216), **without** the top exit I/O feature (7942), and **without** the earthquake feature.

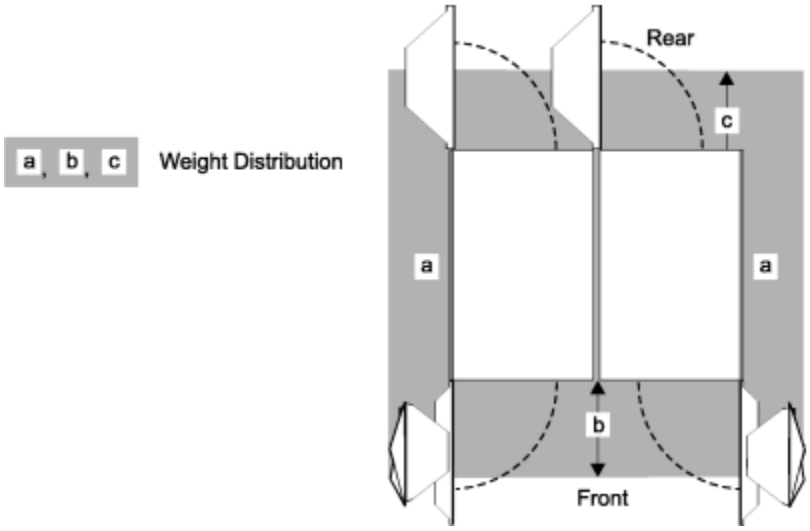


*Table 17. Uniform floor loading for radiator-cooled machine (5245 lbs) **without** internal battery*				
Example #	**'a' (sides) mm (in)**	**'b' (front) mm (in)**	**'c' (rear) mm (in)**	**Floor load kg/m^2 (lbs/ft^2)**
1	25 (1.0)	254 (10.0)	254 (10.0)	897.19 (183.76)
2	25 (1.0)	508 (20.0)	508 (20.0)	725.14 (148.52)
3	25 (1.0)	762 (30.0)	762 (30.0)	615.58 (126.08)
4	254 (10.0)	254 (10.0)	254 (10.0)	726.41 (148.78)
5	254 (10.0)	508 (20.0)	508 (20.0)	592.24 (121.30)
6	254 (10.0)	762 (30.0)	762 (30.0)	506.84 (103.81)
7	508 (20.0)	254 (10.0)	254 (10.0)	607.57 (124.44)
8	508 (20.0)	508 (20.0)	508 (20.0)	499.81 (102.37)
9	508 (20.0)	762 (30.0)	762 (30.0)	431.17 (88.31)
10	762 (30.0)	254 (10.0)	254 (10.0)	527.79 (108.10)
11	762 (30.0)	508 (20.0)	508 (20.0)	437.71 (89.65)
12	762 (30.0)	762 (30.0)	762 (30.0)	380.39 (77.91)

Table 18. Uniform floor loading for radiator-cooled machine (5916 lbs) ***with*** *internal battery*				
Example #	**'a' (sides) mm (in)**	**'b' (front) mm (in)**	**'c' (rear) mm (in)**	**Floor load kg/m^2 (lbs/ft^2)**
1	25 (1.0)	254 (10.0)	254 (10.0)	1002.85 (205.40)
2	25 (1.0)	508 (20.0)	508 (20.0)	807.31 (165.35)
3	25 (1.0)	762 (30.0)	762 (30.0)	682.86 (139.86)
4	254 (10.0)	254 (10.0)	254 (10.0)	808.77 (165.65)
5	254 (10.0)	508 (20.0)	508 (20.0)	656.34 (134.43)
6	254 (10.0)	762 (30.0)	762 (30.0)	559.28 (114.55)
7	508 (20.0)	254 (10.0)	254 (10.0)	673.73 (137.99)
8	508 (20.0)	508 (20.0)	508 (20.0)	551.27 (112.91)
9	508 (20.0)	762 (30.0)	762 (30.0)	473.30 (96.94)
10	762 (30.0)	254 (10.0)	254 (10.0)	583.06 (119.42)
11	762 (30.0)	508 (20.0)	508 (20.0)	480.72 (98.46)
12	762 (30.0)	762 (30.0)	762 (30.0)	415.59 (85.12)

Table 19. Uniform floor loading for water-cooled machine (5349 lbs) ***without*** *internal battery*				
Example #	**'a' (sides) mm (in)**	**'b' (front) mm (in)**	**'c' (rear) mm (in)**	**Floor load kg/m^2 (lbs/ft^2)**
1	25 (1.0)	254 (10.0)	254 (10.0)	867.02 (177.58)
2	25 (1.0)	508 (20.0)	508 (20.0)	708.68 (145.15)
3	25 (1.0)	762 (30.0)	762 (30.0)	605.86 (124.09)
4	254 (10.0)	254 (10.0)	254 (10.0)	702.87 (143.96)
5	254 (10.0)	508 (20.0)	508 (20.0)	579.45 (118.68)
6	254 (10.0)	762 (30.0)	762 (30.0)	499.28 (102.26)
7	508 (20.0)	254 (10.0)	254 (10.0)	588.67 (120.57)
8	508 (20.0)	508 (20.0)	508 (20.0)	489.46 (100.25)
9	508 (20.0)	762 (30.0)	762 (30.0)	425.06 (87.06)
10	762 (30.0)	254 (10.0)	254 (10.0)	511.97 (104.86)
11	762 (30.0)	508 (20.0)	508 (20.0)	429.12 (87.89)
12	762 (30.0)	762 (30.0)	762 (30.0)	375.26 (76.86)

*Table 20. Uniform floor loading for water-cooled machine (6020 lbs) **with** internal battery*				
Example #	**'a' (sides) mm (in)**	**'b' (front) mm (in)**	**'c' (rear) mm (in)**	**Floor load kg/m^2 (lbs/ft^2)**
1	25 (1.0)	254 (10.0)	254 (10.0)	966.96 (198.05)
2	25 (1.0)	508 (20.0)	508 (20.0)	787.39 (161.27)
3	25 (1.0)	762 (30.0)	762 (30.0)	670.75 (137.38)
4	254 (10.0)	254 (10.0)	254 (10.0)	780.80 (159.92)
5	254 (10.0)	508 (20.0)	508 (20.0)	640.82 (131.25)
6	254 (10.0)	762 (30.0)	762 (30.0)	549.86 (112.62)
7	508 (20.0)	254 (10.0)	254 (10.0)	651.27 (133.39)
8	508 (20.0)	508 (20.0)	508 (20.0)	538.78 (110.35)
9	508 (20.0)	762 (30.0)	762 (30.0)	465.73 (95.39)
10	762 (30.0)	254 (10.0)	254 (10.0)	564.31 (115.58)
11	762 (30.0)	508 (20.0)	508 (20.0)	470.28 (96.32)
12	762 (30.0)	762 (30.0)	762 (30.0)	409.25 (83.82)

All measurements are taken from the outside edge of the machine frame, without covers, unless specifically described otherwise.

Minimum weight distribution is shown in the shaded area of Figure 14 on page 73.

- "a" = side dimension
- "b" = front dimension
- "c" = rear dimension

Structural integrity and seismic support

The 3906 is structurally designed to be transported, installed, relocated, and operated in customer environments without loss of functionality and without structural failure or cosmetic damage. Equipped with certain features (weight distribution kit (FC 9970), raised floor frame stiffening and tie-down kit for radiator-cooled (FC 8003), raised floor frame frame stiffening and tie-down kit for water-cooled (FC 8004), or nonraised floor frame frame stiffening and tie-down kit FC 8005), the 3906 is capable to withstand high magnitude earthquake events without functional degradation during and after earthquake events.

This section addresses environmental conditions or the level that the 3906 tested and verified.

Note: The vibration and shock levels given here are the levels that 3906 tested and verified and not the upper limit of what the system can withstand. If you have any environmental conditions higher than specified here, please contact your IBM representatives.

There are three shock and vibration levels:

- Ruggedness (Fragility)
- Operational shock and vibration
- Seismic resistance

Ruggedness (Fragility)

Ruggedness relates to a product's ability to withstand the shipping and relocation environments without structural damage. Product ruggedness is assured through shipping shock, vibration, and horizontal

impact testing. Passing the test requirements include no short-term and long-term structural and functional degradation. Ruggedness is a key focus item during the new product design phase. Significant analysis and testing efforts are typically associated with new product and subassembly designs to ensure adequate ruggedness for frames, fragile components, and assemblies. To ensure broad protection against shock and vibration, the subassemblies and minimum and maximum system configurations are subjected to unpackaged and packaged testing to cover possible shipping configurations.

Focus on system level or the frame with its drawers installed include:

- Excessive deflection of chassis during drop test
- Yielding of drawer chassis, rack rails, cages, and subassemblies
- Excessive frame transmissibility

Focus on subassembly level or drawers not installed in a frame include:

- Heatsink retention
- Chip damage due to heatsink loading
- Card interconnect damage
- Card retention and latching
- Card connector fretting wear
- Card and cable connectors
- Power supply assembly fragility
- Cooling components air moving devices
- Hinges and doors

Test levels

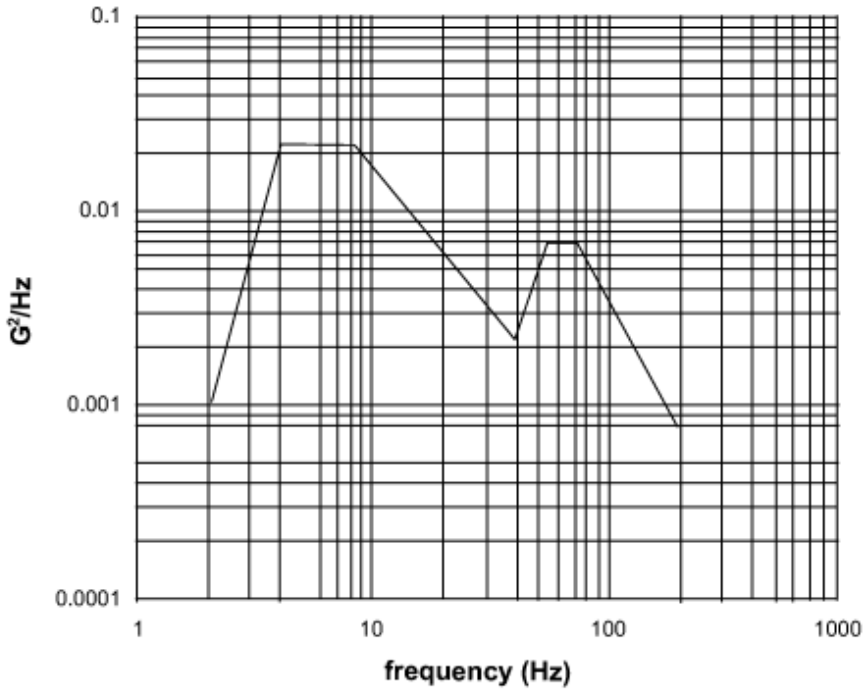
There are two vibration test profiles:

- Sinusoidal at 0.5 g sweep from 2-200 Hz for a total of 30 minutes
- Random vibration for 15 minutes with power spectral density as shown in Table 21 on page 56.

For system level testing, the system is subjected to vertical direction vibration.

For subassembly testing, the test is conducted on all three perpendicular axis.

*Table 21. Truck, air, rail, and ocean vibration spectrum **

Frequency (Hz)	G^2/Hz (PSD level)	graph representation
2	0.0010	
4	0.0220	
8	0.0220	
40	0.0022	
55	0.0070	
70	0.0070	
200	0.0007	

Note: * A rms = 0.8044 G, V rms = 4.508 in/s, D rms = 0.1578 in zero to peak

There are two shock test levels:

- System level or the frame with its drawers installed – vertical direction
  10 times free fall drops at 39.3 in/s velocity change
  2 times free fall drops at 55.6 in/s velocity change
- Subassembly or drawers level – in all 6 faces
  100 g, 3 ms half sine pulse 2x per face
  50 g, 11 ms half sine pulse 2x per face

Since 1980, the shock test levels previously specified and vibration test levels specified in Table 21 on page 56 have been utilized. No documented cases of field problems associated with normal shipping shock and vibration exist.

Operational shock and vibration

Operational shock and vibration relates to a product's ability to withstand normal shock and vibration from its installation environments without functional degradation. Although the shock and vibration sources are typically from the surrounding environment (nearby cooling operating equipment, people walking by or dropping materials, etc.), they also can be self-induced (vibration from fans, blowers, compressors, etc.).

Test levels

All the 3906 systems while running are verified to meet the vertical vibration level given in Table 22 on page 57 and Figure 9 on page 58 without any functional degradation. The 3906 is verified to be able to withstand five vertical shock inputs 3.5 g with 3 ms half sine pulse width.

Table 22. Random vibration PSD profile breakpoint [1]

Class	5 Hz	17 Hz	45 Hz	48 Hz	62 Hz	65 Hz	150 Hz	200 Hz	500 Hz
V1L/V2	$2.0x10^{-7}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$	$2.2x10^{-5}$

Notes:

1. All values in this table are in g^2/Hz.
2. For reference only. No test required.

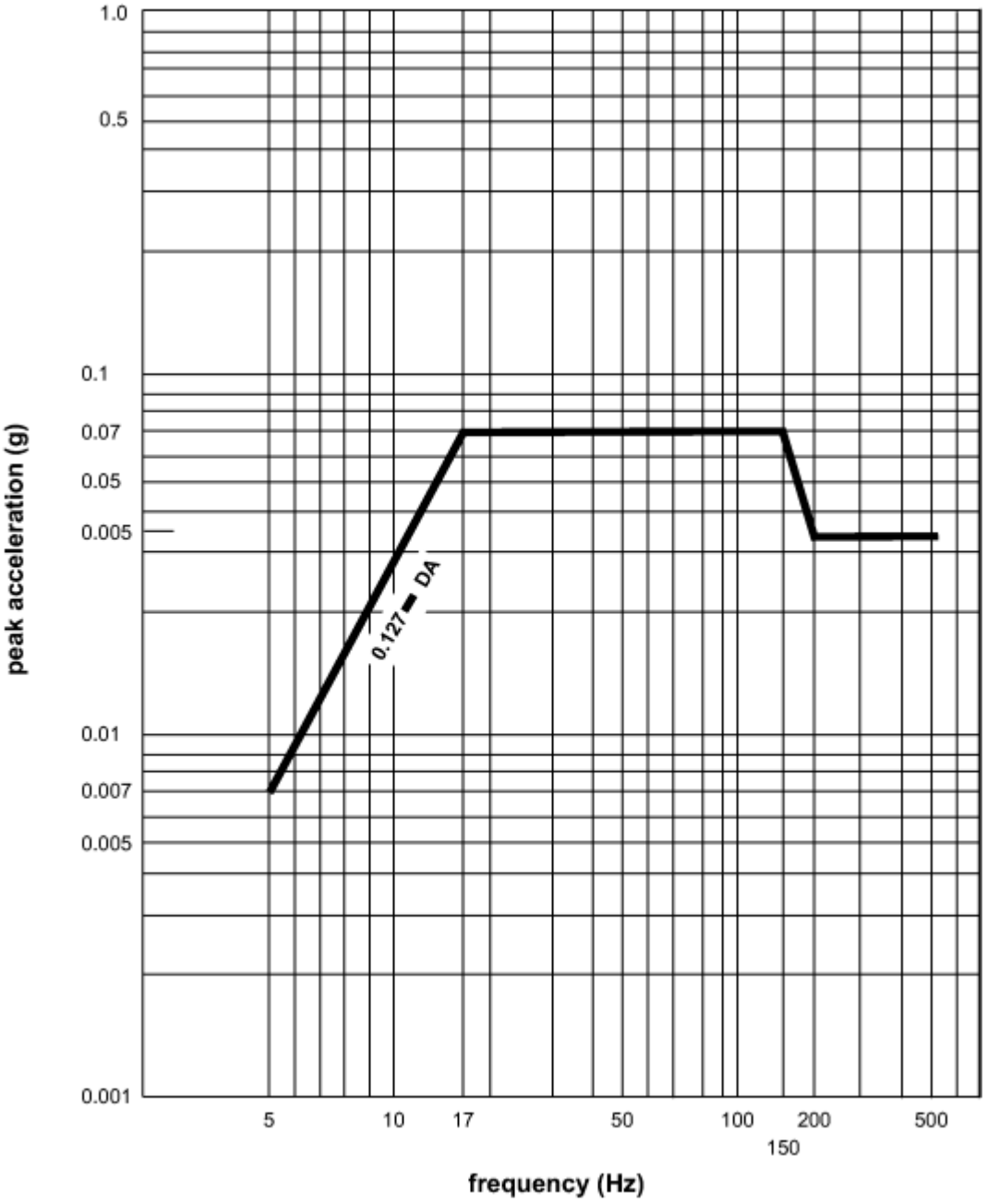


Figure 9. Continuous operational vibration

Documented cases of field problems associated with externally imposed shock and vibration during normal equipment operation are essentially nonexistent.

Seismic (Earthquake) resistance

In earthquake areas, the 3906 equipped with the appropriate earthquake kits are certified to meet requirements ICC IES AC156 with the following test parameters:

Table 23. AC156 parameters used for Required Response Spectrum (RRS)

Test criteria	S_{DS} (g)	z/h	Horizontal		Vertical	
A_{FLX-H}	A_{RIG-H}	A_{FLX-V}	A_{RIG-V}			
ICC-ES AC156	2.5	1.0	4.00	3.00	1.68	0.68
ICC-ES AC156	2.0	1.0	3.20	2.40	1.34	0.54

Notes:

- S_{DS} = Design spectral response acceleration at short period
- A_{FLX-H} = Horizontal spectral acceleration calculated for flexible components
- A_{RIG-H} = Horizontal spectral acceleration calculated for rigid components
- A_{FLX-V} = Vertical spectral acceleration calculated for flexible components
- A_{RIG-V} = Vertical spectral acceleration calculated for rigid components

The above S_{DS} parameters 2.5 g represents the high magnitude covering most of densely populated area in California. As an example S_{DS} values for Los Angeles (1.29 g), San Francisco (2.00 g), Santa Barbara (2.00 g), and San Diego (1.60 g).

In addition, the 3906 was tested to Telcordia NEBS (National Equipment Building Specifications) zone 4 seismic test profile. During and after the test, no system functional interruption was observed with only the front and rear covers opening during testing.

A mainframe computer's structure consists of a frame or rack, drawers with central processor units, I/O equipment, memory, and other electronic equipment. The focus of this structural mechanical analysis and design is on the frame, earthquake stiffening brackets, and frame tie-down methods. The primary function of the frame is to protect critical electronic equipment in two modes. The first mode is during shipping shock and vibration, which provides excitation primarily in the vertical direction. The second mode of protection is protecting the equipment during seismic events where horizontal vibration can be significant. Frame stiffening brackets and tie-downs are features added to mainframe systems that must meet earthquake resistance requirements. Designing to withstand seismic events requires significant analysis and test efforts because the functional performance of the system must be maintained during and after seismic events. The frame stiffening brackets and anchorage system must have adequate strength and stiffness to counteract earthquake-induced forces, thereby preventing human injury and potential system damage. The frame's stiffening bracket and tie-down combination must ensure continued system operation by limiting overall displacement of the structure to acceptable levels, while not inducing undue stress to the critical electronic components.

Quality screen (Manufacturing stress screening)

One application of shock and vibration technology that falls outside the design function is manufacturing stress screening and field failure analysis of intermittent subassemblies, such as the 3906 power supplies. By subjecting samples of production subassemblies to screening tests, it is possible to detect certain manufacturing, component, and design problems in these subassemblies. Typical tests include thermal cycling and random vibration, followed by burnin and functional test at a vendor or subassembly manufacturer.

Weight distribution kit (FC 9970)

Note: When the machine is shipped to the customer site, the personnel delivering the machine may have positioned the machine on the a raised floor using two steel weight distribution plates, **P/N 44P3326**, to prevent permanent deformation of the raised floor. (The steel weight distribution plates are part of the weight distribution plate kit, **P/N 00RY505**.) The delivery service may have also placed the machine in the planned final installation location. If the machine is in the final planned installation location, the IBM representative will have to install the weight distribution bars, **P/N 45D1602**. The steel plates, **P/N 44P3326**, are optional, so the IBM representative will have to determine whether to keep them in place or remove them. Keeping them in place will not interfere with the installation and normal operation of the machine. If the weight distribution bars and steel plates have been previously installed and the machine has to be moved, the IBM representative will have to remove the weight distribution bars and steel plates, and then reinstall the weight distribution bars.

Note: The rolling load rating of a raised floor tile represents its capacity to support one loaded wheel crossing it at a time. Translating this rating to floor capacity, the nature of floor evenness and caster height variation, a factor of three (3) is recommended to be applied. For example, a system weighing 2400 lb and having a caster spacing greater than 24 inches, it is recommended that the floor tile have a minimum rolling load rating of 800 lb.

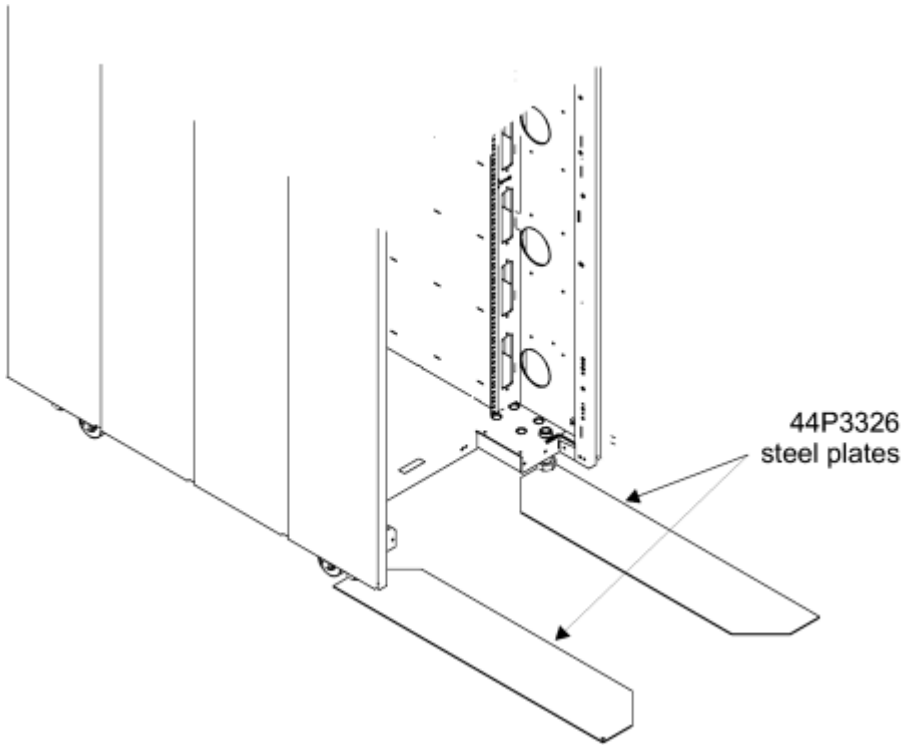
To install the weight distribution bars, **P/N 45D1602**, the **IBM representative** would complete the following steps on each frame:

__ 1. Locate the weight distribution kit, **P/N 00RY505**.

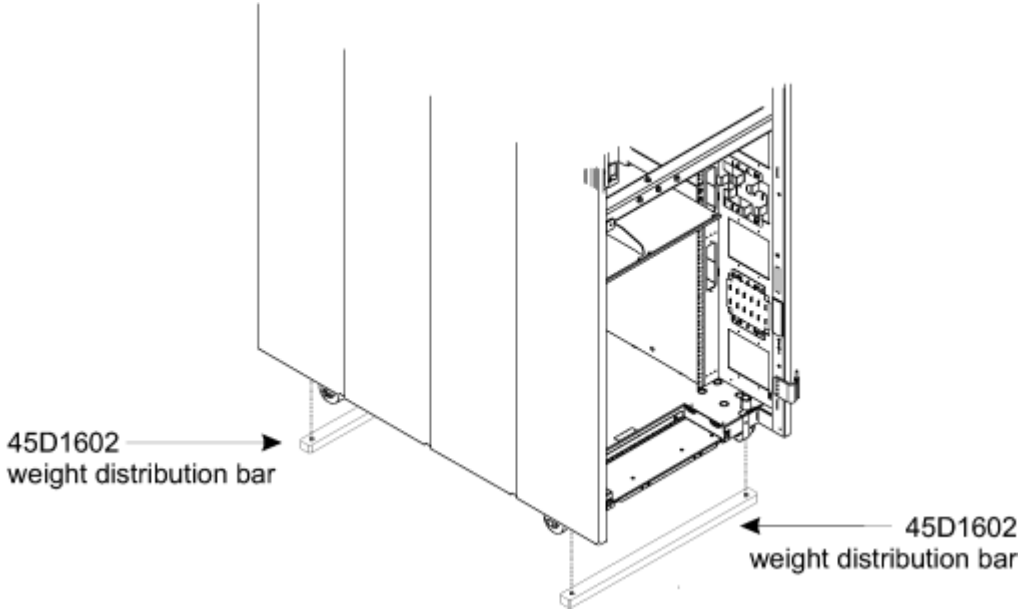
If the steel weight distribution plates are going to be used, lay them in the front of the last floor covering at the final installation location (on which the rack will be rolled into position). Avoid floor tiles with cutouts.

When moving to the final install location, plexiglass sheets are generally used to protect the floor tiles. As the machine nears its final location, ensure that the metal plates are placed down first. Then place the plexiglass down with some overlap, so that the machine comes down from the plexiglass sheet onto the metal plates.

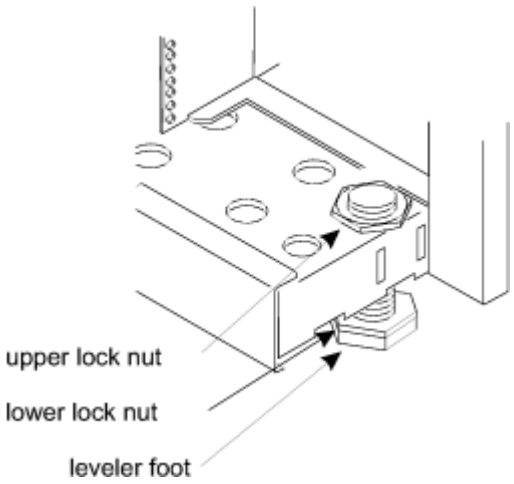
Note: It may be helpful to use any regular packing tape to affix the steel plates to the floor to help prevent steel plates from moving as the frame is rolled onto them. Be sure to follow any static electricity requirements at the customer location and remove the tape at the end of the installation process.



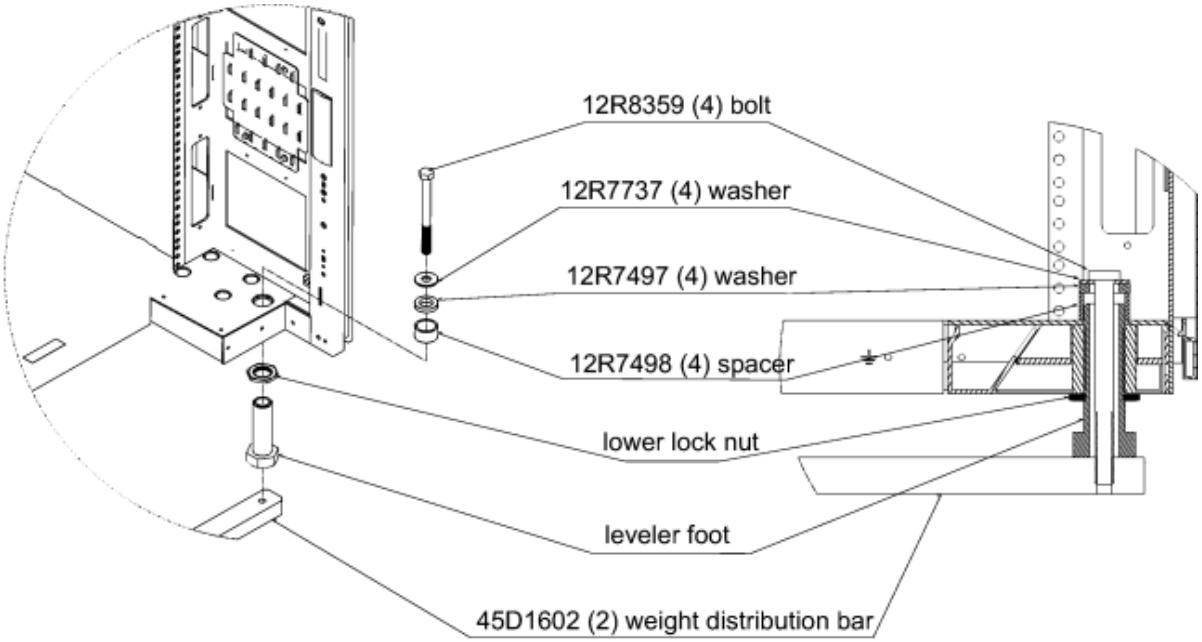
__ 2. In the kit, find the four weight distribution bars, **P/N 45D1602**, (2 bars per frame) in the ship group and place them under the front and rear leveler feet of each frame.



__ 3. Use the wrench, **P/N 31L8313**, supplied in the basic ship group, to loosen and remove the upper lock nut. Store the lock nut for future use when the system is relocated or discontinued.



__ 4. Find the mounting hardware in the weight distribution kit, **P/N 00RY421**, as shown below.

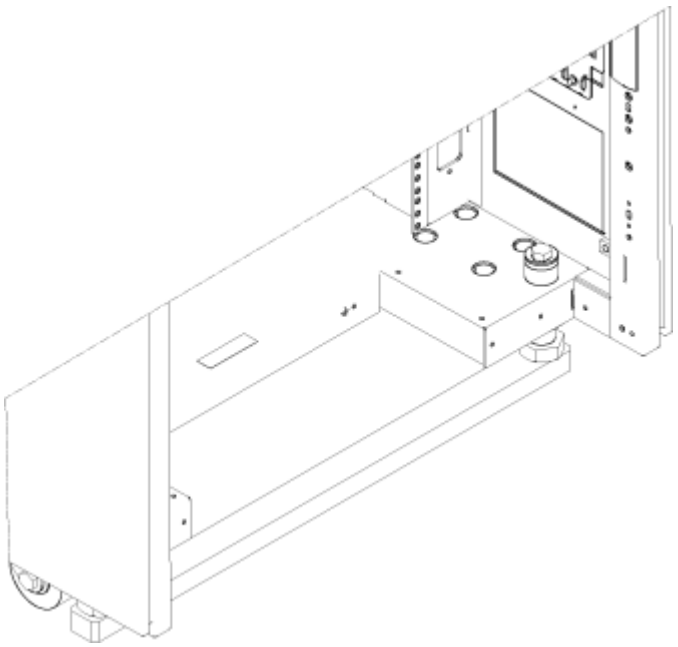


__ 5. Install a spacer, two washers and a bolt down through the top of each leveler foot and thread the bolt into each end of each leveling bar.

__ 6. Use the wrench, **P/N 31L8313**, supplied in the basic ship group, to lower the leveler foot at each corner of the A frame. Lower each leveler foot enough to transfer the frame weight from the caster to the leveler foot.

__ 7. Hold the leveler foot in contact with the weight distribution bar and turn the lower lock nut up until it contacts the bottom of the frame. While holding the leveler foot in place with one hand, tighten the lock nut using the wrench with your other hand.

__ 8. Tighten the four bolts from the weight distribution kit into the weight distribution bars.



__ 9. Repeat these steps for the Z frame.

Frame-stiffening and tie-down -- Earthquake kit

The purpose of this section is to describe the frame stiffening and tie-down kit that will provide frame ruggedizing and the floor tie-down hardware for securing a frame. The kit is designed to help secure the frame and its contents from damage when exposed to vibrations and shocks such as those in a seismic event. (See Figure 10 on page 65 and Figure 11 on page 66.)

FC 8003 (for radiator-cooled) and FC 8004 (for water-cooled) is used on a raised floor. FC 8005 is used on a nonraised floor.

Note:

- A single FC provides hardware for the two frames.
- The earthquake kit is provided based on certain test results on specific test profiles under laboratory conditions. The tests results may not be realized in all external environments or customer environments. Therefore, no assurance or warranty can be given.

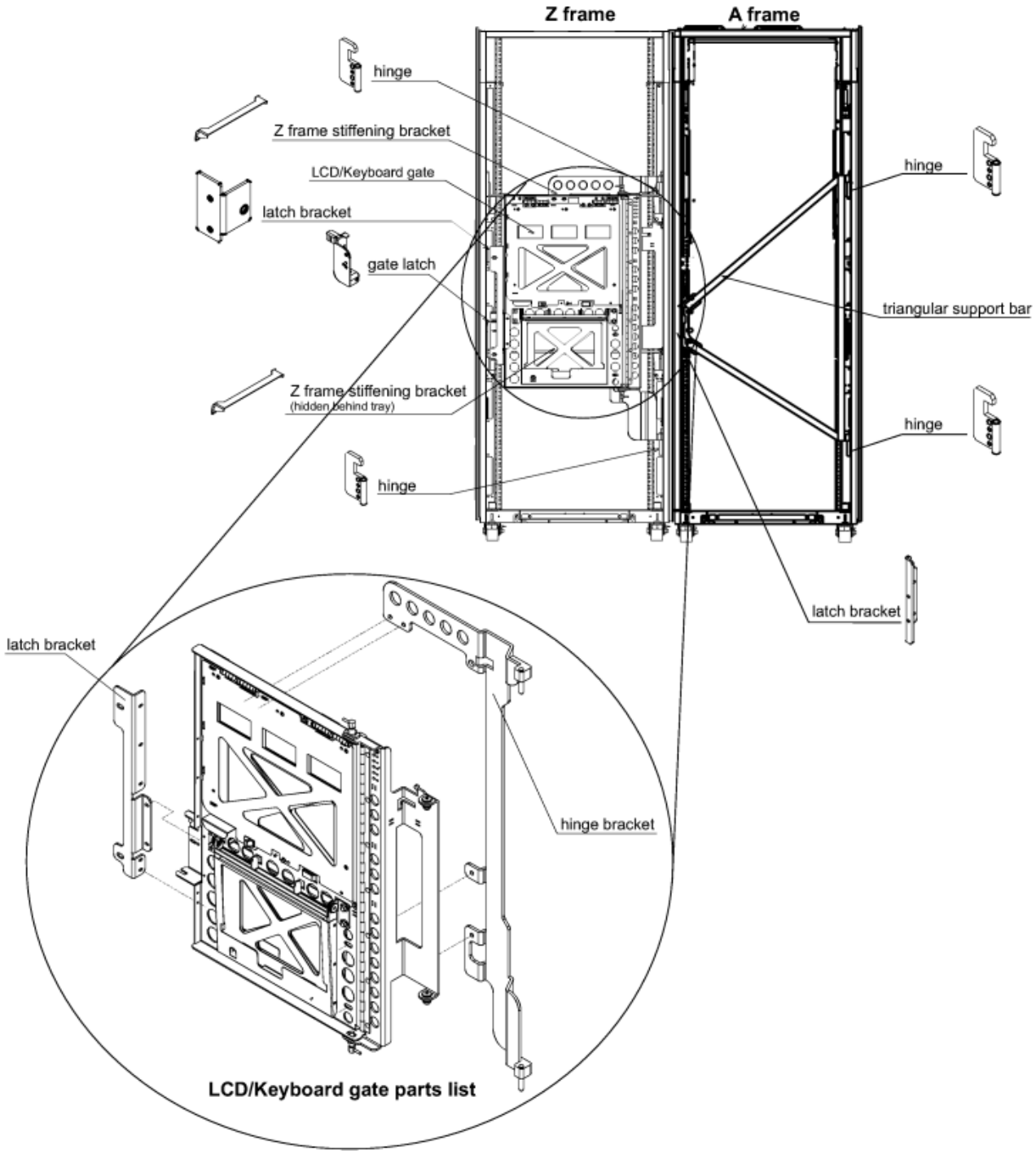


Figure 10. Frame stiffening and tie-down parts list - front frame

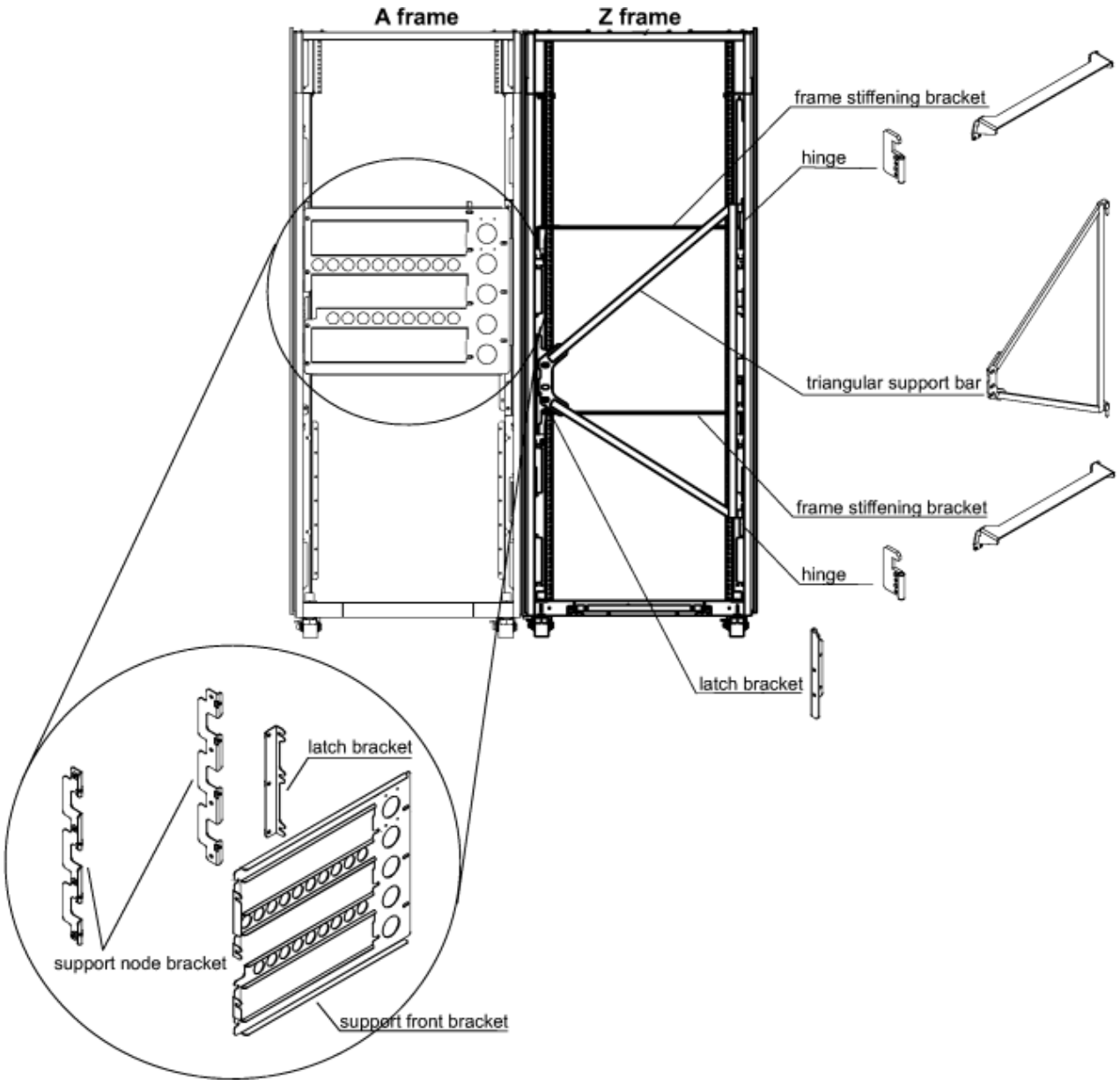


Figure 11. Frame stiffening and tie-down parts list - rear frame

Raised floor frame tie-down

Frame tie-down for the 3906 on a raised floor is a system of adjustable turnbuckles intended to fasten each corner of the server frames to eyebolts installed in the concrete floor beneath your computer room raised floor. FC 8003 and FC 8004 supply parts to cover raised floor heights from 152.4 mm (6 inches) to 914.4 mm (36 inches).

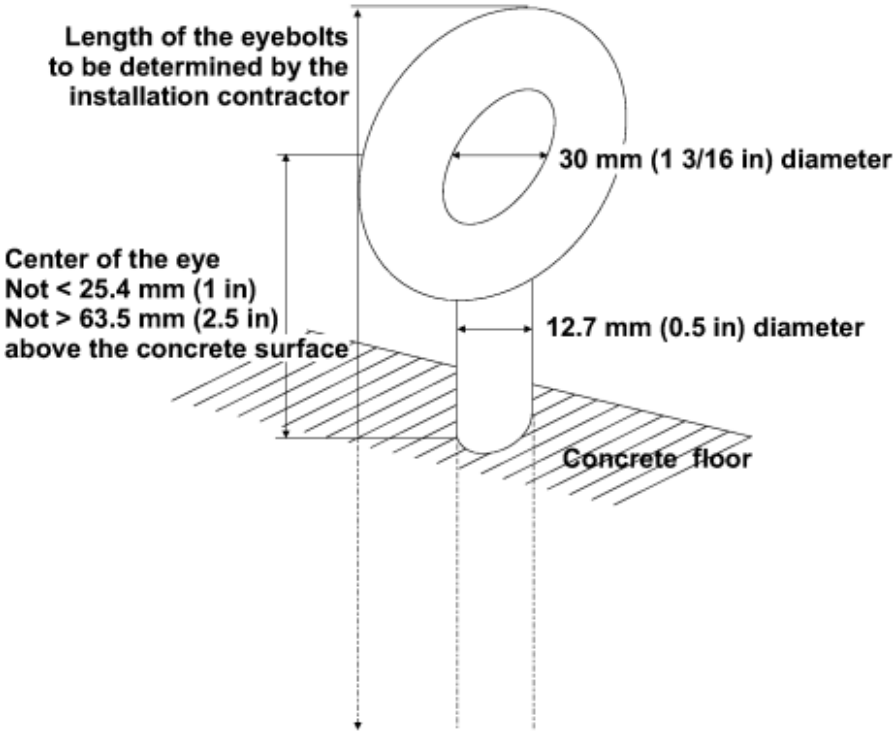
Note: For a water-cooled model on a raised floor, the height of the raised floor (subfloor to top surface of floor tile) must be a minimum of 228.6 mm (9 inches) to accommodate the bend radius of the water hoses.

You are responsible for obtaining the services of a qualified consultant or structural engineer to determine what must be done at your particular location to install **four eyebolts per frame**. These eyebolts should be capable of withstanding the appropriate seismic forces for a frame weighing up to 1362 kg (3000 lbs) with the center of gravity 1270 mm (50 inches) from the ground and at the center of the frame.

Installing the eyebolts

You are responsible for obtaining and installing the eyebolts that will anchor the frames of your 3906. Following are the specifications for the eyebolts:

- 12.7 mm (0.5 in) diameter, 13 threads per inch (length to be determined by the qualified contractor who will perform the eyebolt installation)
- Inside diameter of the eye not smaller than 30 mm (1 3/16 in)
- Installed so that the center of the eye is not less than 25.4 mm (1 in) nor more than 63.5 mm (2.5 in) from the surface of the concrete floor.



Regardless of which kit you need, the following figures show where to cut the floor panels for the turnbuckles to pass through to the eyebolts set in the concrete floor beneath.

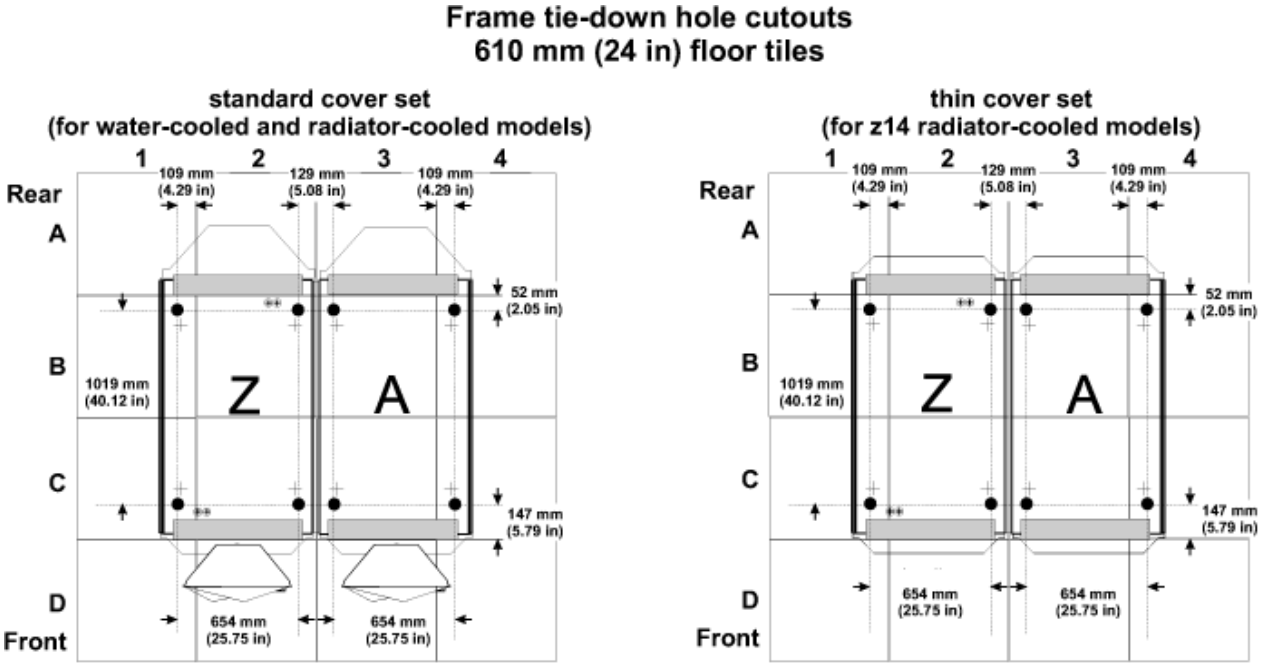


Figure 12. Frame tie-down hole cutouts 610 mm (24 in) floor tiles

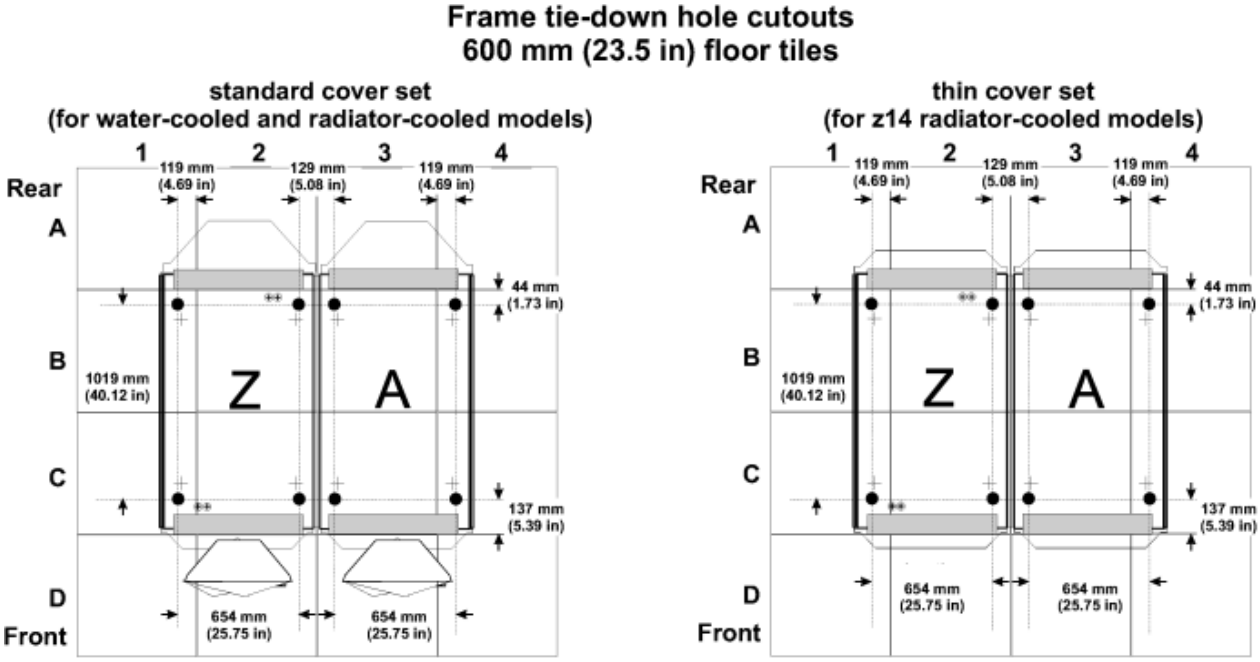


Figure 13. Frame tie-down hole cutouts 600 mm (23.5 in) floor tiles

Additional floor panel pedestals may be necessary to restore structural integrity to the raised floor after making the circular cuts for the turnbuckles. Consult your flooring manufacturer for recommendations.

The remainder of the parts involved in any of the tie-down features include:

- New cable bars, fastened where the original cable trays were mounted
- A triangular support bar, hung on two hinges and secured with a vertical stop
- A latch for the triangular support bar

- A pair of stabilizer bars that rest on the raised floor between the corners of each frame
- Four turnbuckle assemblies with fastening hardware that extend through the raised floor and are secured to the eyebolts
- Heavier cover door latches.

These additional tie-down parts are installed along with the server. The installation instructions are included as an appendix in the *3906 Installation Manual*, which is shipped with the server.

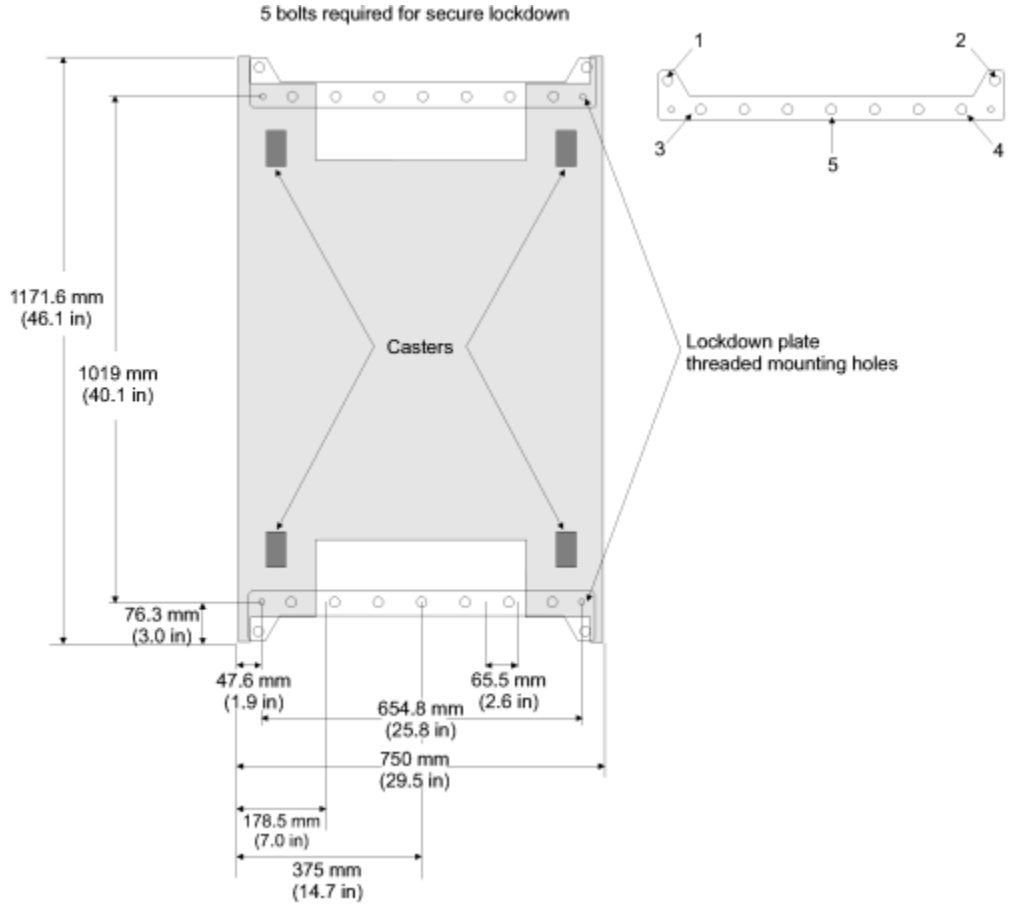
Nonraised floor frame tie-down

The purpose of this installation instruction is to install a frame tie down kit that will provide hardware for securing a frame to a concrete nonraised floor. This kit (FC 8005) is designed to help secure the frame and its contents from damage when exposed to vibrations and shocks such as those in a seismic event.

You are responsible for obtaining the services of a qualified consultant or structural engineer to determine what must be done at your particular location to install **five anchors per lock down plate** and for securing the front and rear lock down plate to the concrete floor according to the following illustration.

Contact your marketing representative well ahead of server delivery to obtain the lock down plate so that the site will be ready when the server arrives.

Use the following illustration to plan carefully where the anchors that secure the stabilizers must be installed.



The lock down plate to concrete fasteners should be a **heavy duty expansion anchor**. The contractor you engage to install the stabilizers will determine the length of the anchors.

When the server arrives, remove the fasteners from either the front or rear stabilizer. Remove the stabilizer to position the server frame. Then reinstall the stabilizer and the fasteners before the service provider begins the installation.

System weight examples

Following is a table that provides weight estimates for minimum, typical, and maximum configurations on all 3906 models. The Power Estimator tool has been modified to include weight data and now has the capability to provide a more accurate weight for your particular configuration. See "Power estimation tool" on page 110.

Table 24. Weights for minimum, typical, and maximum server configurations

Weight (in lb) for a radiator-cooled server				Additional weights (in lb) for features [2]				
Model	**Minimum weight**	**Typical weight**	**Maximum weight**	**Water weight addition**	**Top exit I/O weight**	**Battery weight**	**Balanced power**	**Earthquake feature**
M01 or LM1	2769	3307	3665	127	156	447 [1]	239	180
M02 or LM2	2948	3880	4697	127	156	671	109	180
M03 or LM3	3227	4533	4975	104	156	671	55	180
M04 or LM4	3485	4783	5233	104	156	671	0	180
M05 or LM5	3498	5110	5246	104	156	671	0	180

Note:

1. The additional weight is for an M01 or LM1 (maximum) without balanced power. With balanced power, the addition weight is 671 lb. For one processor drawer (typical and minimum) and two processor drawers (minimum), the addition weight is 477 lb.
2. All weights include the standard cover set. For the thin cover set on the z14 radiator-cooled models, reduce the weights by 108 lb.
3. Minimum weights include no listed features and no I/O.
4. Maximum weight includes five PCIe I/O drawers (FC 4012) and no listed features. All slots in the PCIe I/O drawers contain an adapter. The exception is the one processor drawer (M01 or LM1) model, which is limited in content.
5. Typical weights contain I/O considered typical in a balanced system for the respective model.
6. The additional weight for features is valid for the maximum system power of each configuration.
7. The additional weights listed in the table are for maximum configured systems (maximum I/O drawers). Actual weight will vary and can only be determined by using the power and weight estimation tool with an exact specification of content. This tool is available on Resource Link (*http://www.ibm.com/servers/resourcelink*).

Example: A typical radiator-cooled M02 with batteries and balanced power = 3885 + 671 + 109 = 4665 lbs

Weight distribution and multiple systems

Under typical conditions, service clearances of adjacent products may be overlapped but weight distribution areas should not be overlapped. If weight distribution clearances are overlapped, the customer should obtain the services of a qualified consultant or structural engineer to determine floor loading. Regardless of floor loading, minimum service and aisle clearances must be observed:

- Rear dimension "d" is **990.6 mm (39 in)**
- Front dimension "e" is **1168.4 mm (46 in)**
- Both "d" and "e" are measured from the frame edge (without covers) to the nearest obstacle
- Cover opening dimensions are also shown.

Note: Aisle clearances are not the same between rows of front-facing and rear-facing covers. Front-facing rows require **1168.4 mm (46 in)** of clearance while rear-facing rows need a **minimum** of **990.6 mm (39 in)**.

For physical planning purposes, you must verify system placement considering:

- Weight distribution
- Power availability
- Power access
- Machine and service clearance area
- Air conditioning delivery
- Chilled water delivery
- Thermal interaction
- Cable locations
- Floor tile cutouts.

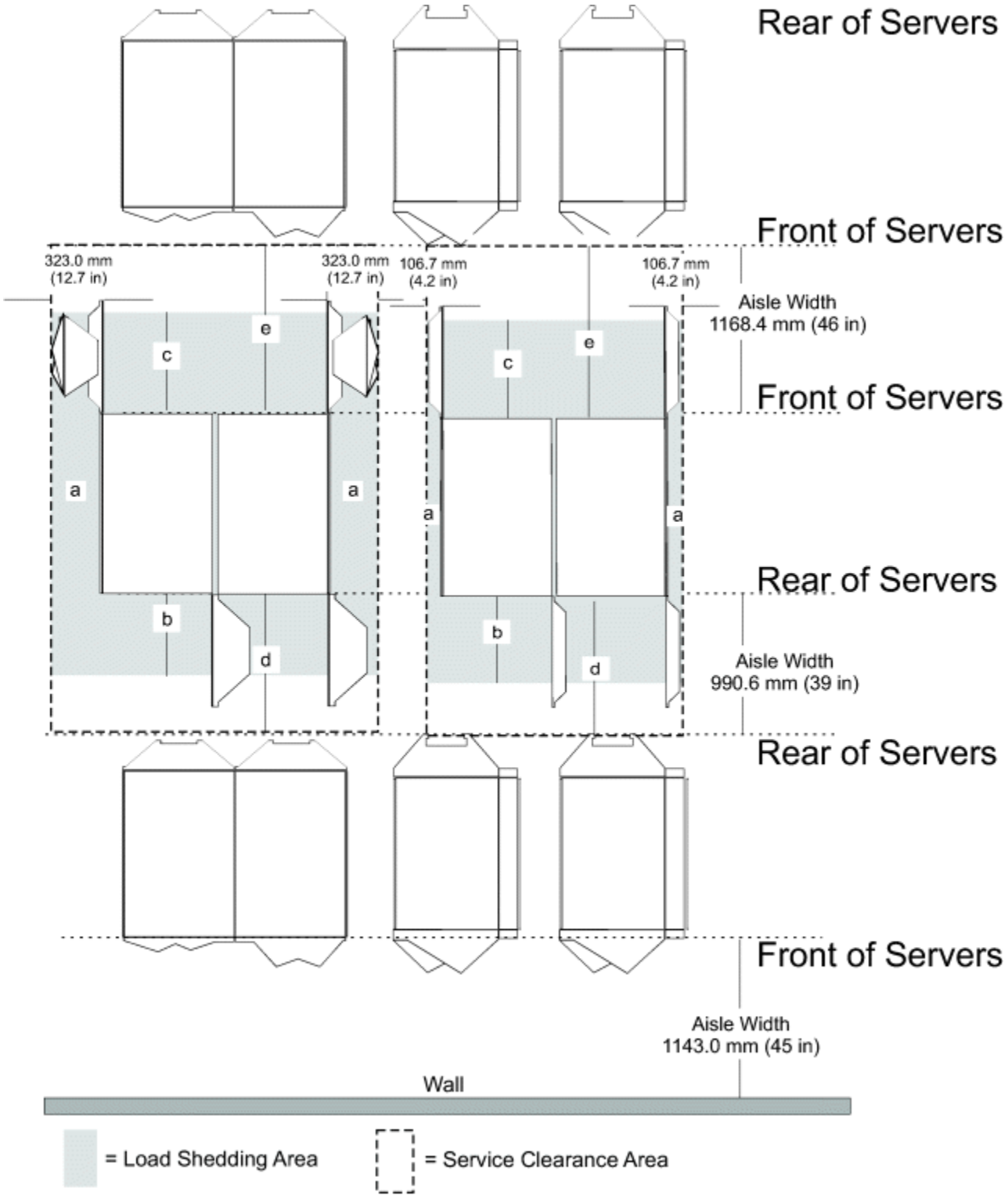


Figure 14. Aisle and service clearances

Machine and service clearance areas

Machine area is the actual floor space covered by the system. Service clearance area includes the machine area, plus additional space required to open the covers for service access to the system.

A and Z frames	Machine area M^2 (ft^2)	Service clearance area M^2 (ft^2)
Radiator-cooled without I/O top exit	2.91 (31.3) [2] 2.33 (25.1) [3]	7.60 (81.8) [2] 6.11 (65.8) [3]
Radiator-cooled with I/O top exit	3.43 (36.9) [2] 2.74 (29.5) [3]	7.60 (81.8) [1, 2] 6.11 (65.8) [1, 3]
Water-cooled without I/O top exit	3.08 (33.2) [2]	7.82 (84.2) [2]
Water-cooled with I/O top exit	3.63 (39.1) [2]	7.82 (84.2) [1, 2]

Notes:

1. The top exit I/O top towers (FC 7942) are an **optional** feature. Service clearance **not shown** for these towers.
2. Includes the installed standard front cover 323.0 mm (12.7 in) and standard rear cover 266.7 (10.5 in).
3. For z14 radiator-cooled models, includes the installed thin front cover 106.7 mm (4.2 in) and thin rear cover 106.7 mm (4.2 in).
4. Service clearance area must be free of all obstacles. Units must be placed in a way that all service areas are accessible. The weight distribution clearance area extending beyond the service clearance area, such as the area at the outside corners of the units, may contain support walls and columns.
5. **Front-to-front aisle spacing of at least 1168.4 mm (46.0 in) is required for water-cooled servers to provide enough space in the front of the machine for fill and drain procedures.**

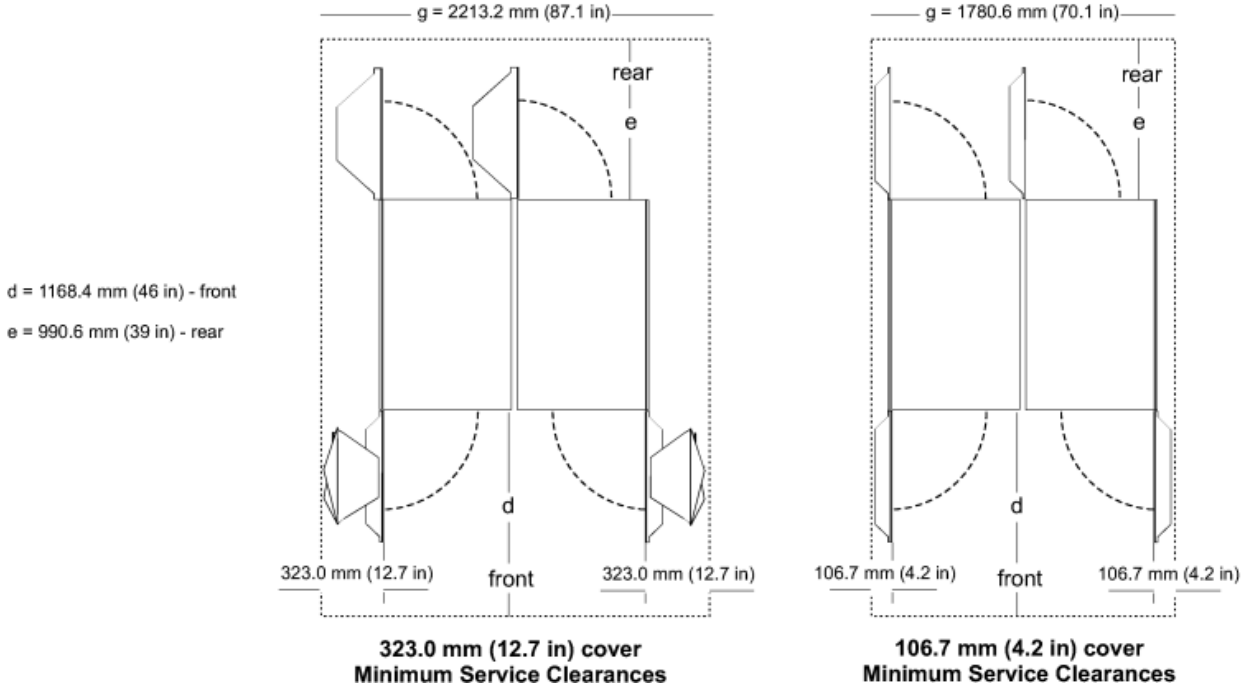


Figure 15. Minimum service clearances

The front and rear covers access all of the serviceable area in the 3906. The system requires specific service clearances to ensure the fastest possible repair in the unlikely event that a part may need to be replaced. Failure to provide enough clearance to open the front and rear covers will result in extended service time.

The following describes some service clearance conditions that must be followed (See Figure 16 on page 76 or Figure 17 on page 77.)

- The side cover of either the A or Z frame cannot be placed adjacent to a wall (Example **A**), but can be positioned next to obstacles such as poles or columns (Example **B**).
- The front standard cover on the Z frame and the rear cover on the A frame open 457.2 mm (18.0 in) wider than the width of the frame plus side cover. This service clearance area is required for mounting the service lift tool. The front standard cover on the A frame opens 323.0 mm (12.7 in) wider than the width of the frame plus side cover (Example **C**).
- The front thin cover on the Z frame and rear thin cover on the A frame open 457.2 mm (18.0 in) wider than the width of the frame plus side cover. The front thin cover on the A frame opens 106.7 mm (4.2 in) wider than the width of the frame plus side cover (Example **C**).
- Service clearances **cannot** be achieved with a 3906 server installed side-cover-to-side-cover. Dimensions are given for a 3906 next to a 3906. To calculate side-to-side clearance, add either 323.0 mm (12.7 in) or 106.7 mm (4.2 in) to the clearance required from the adjacent equipment (Example **D**).

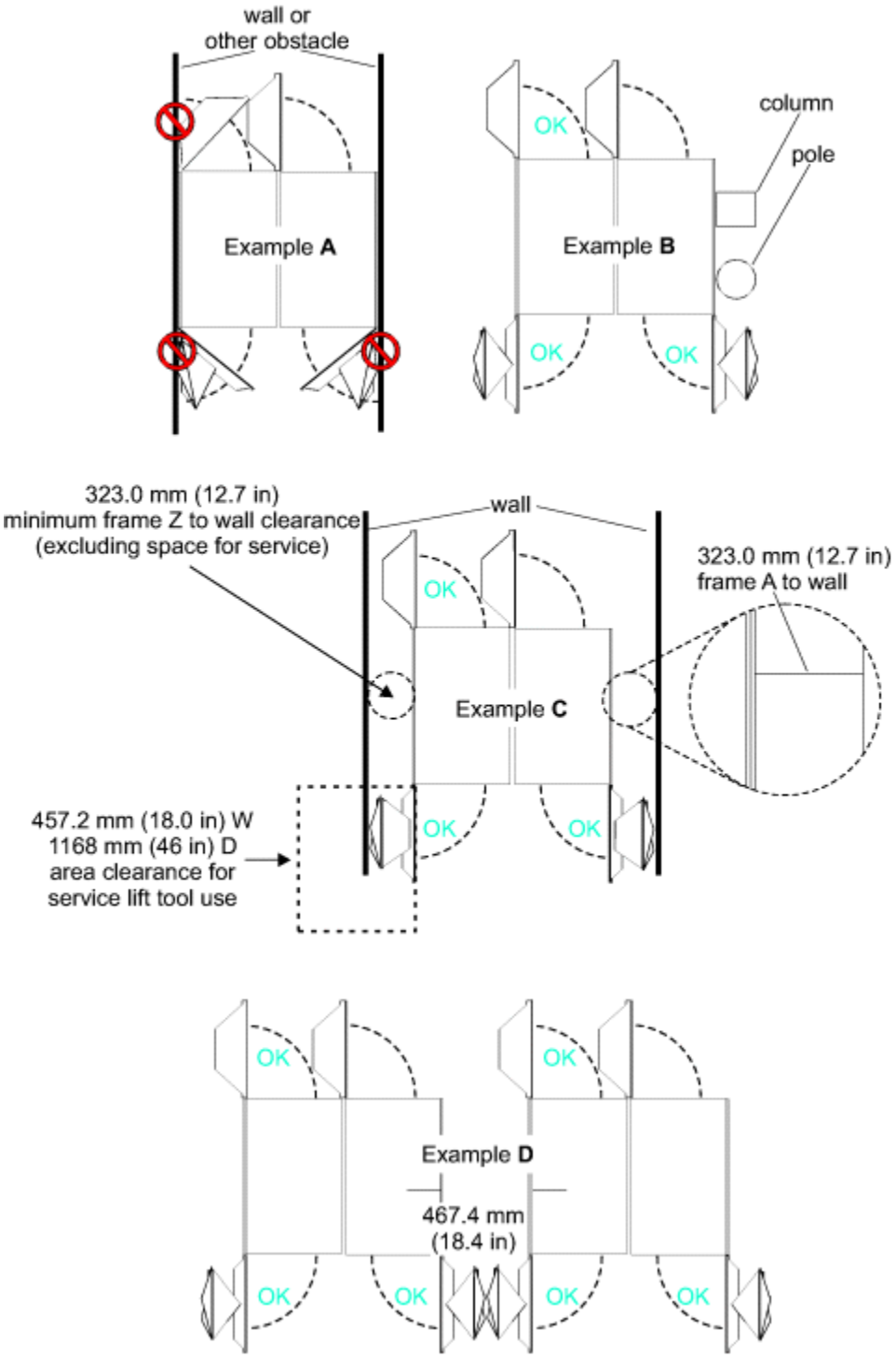


Figure 16. Detailed service clearances - 323.0 mm (12.7 in) cover

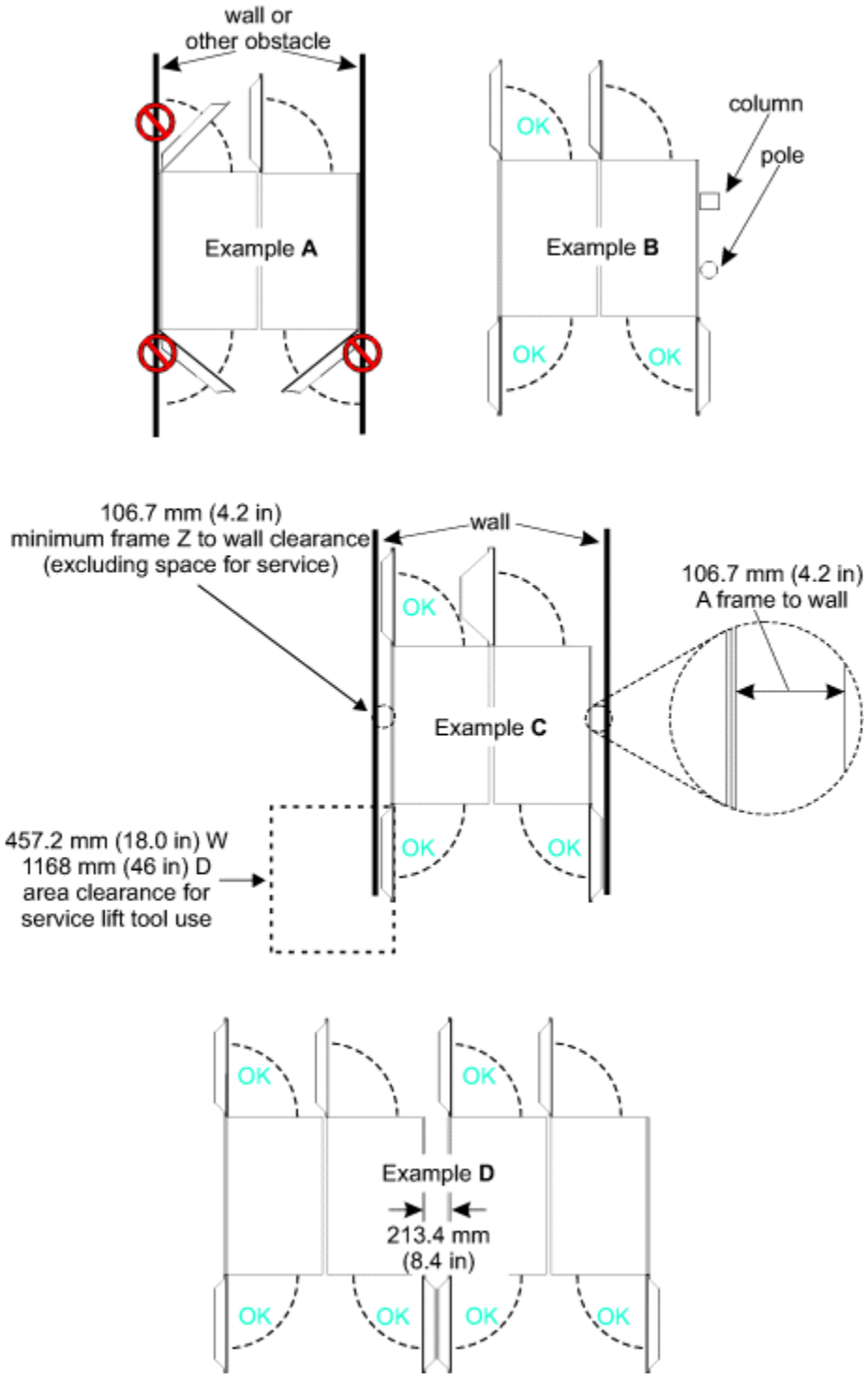


Figure 17. Detailed service clearances - 106.7 mm (4.2 in) cover

Cooling recommendations for the room

The following illustration does not represent any particular server machine type, and is intended only to show hot and cold airflow and the arrangement of server aisles on the raised floor.

A typical 3906 uses chilled air, provided from under the raised floor, to cool the system. As shown below, rows of servers must face front-to front. Chilled air is usually provided through perforated floor panels placed in rows between the fronts of servers (the **cold** aisles shown in the figure). Perforated tiles generally are not placed in the hot aisles. (If your particular computer room causes the temperature in the hot aisles to exceed limits of comfort for activities like system service, you may add as many perforated tiles as necessary to create a satisfactory comfort level.) Heated exhaust air exits the computer room above the computing equipment.

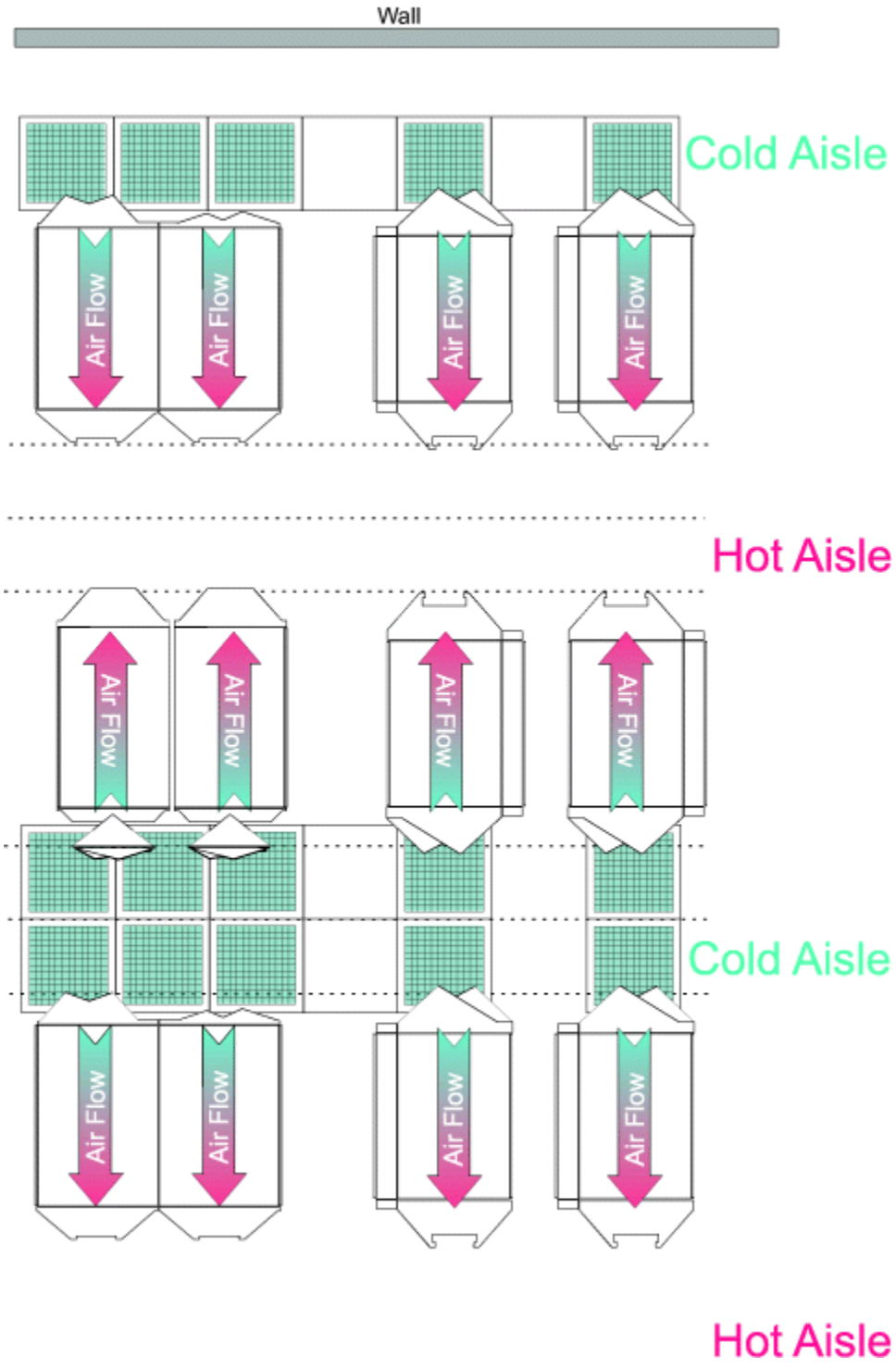


Figure 18. System airflow

The following table and chart illustrate how to determine the amount of chilled air your computer room must provide to meet the environmental requirement for your 3906.

The values in the following chart are for a typical computer room environment:

- Room inlet air = 24^0C
- Customer water inlet = 14^0C or cooler
- Altitude = up to 457 meters (1500 feet) above sea level.
- Dewpoint = 11^0C or less

Table 25. Cooling airflow graph codes - M01 or LM1

Model M01 or LM1	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)
typical	radiator-cooled	6.5	-	6.5
maximum	radiator-cooled	9.8	-	9.8
typical	water-cooled	6.1	6.2	-0.1
maximum	water-cooled	9.5	9.3	0.2

Table 26. Cooling airflow graph codes - M02 or LM2

Model M02 or LM2	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)
typical	Radiator-cooled	10.9	-	10.9
maximum	Radiator-cooled	18	-	18
typical	Water-cooled	10.3	10.2	0.1
maximum	Water-cooled	17.5	16.2	1.3

Table 27. Cooling airflow graph codes - M03 or LM3

Model M03 or LM3	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)
typical	Radiator-cooled	15.7	-	15.7
maximum	Radiator-cooled	22.3	-	22.3
typical	Water-cooled	15	15	0
maximum	Water-cooled	21.5	20.4	1.1

Table 28. Cooling airflow graph codes - M04 or LM4

Model M04 or LM4	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)
typical	Radiator-cooled	19.1	-	19.1
maximum	Radiator-cooled	26.9	-	26.9
typical	Water-cooled	17.8	17.8	0
maximum	Water-cooled	25.5	24.9	0.6

Table 29. Cooling airflow graph codes - M05 or LM5				
Model M05 or LM5	**Cooling method**	**Total power (in kw)**	**Power to water (in kw)**	**Power to air (in kw)**
typical	Radiator-cooled	21.5	-	21.5
maximum	Radiator-cooled	28.5	-	28.5
typical	Water-cooled	20.1	20.1	0
maximum	Water-cooled	27	26.3	0.7

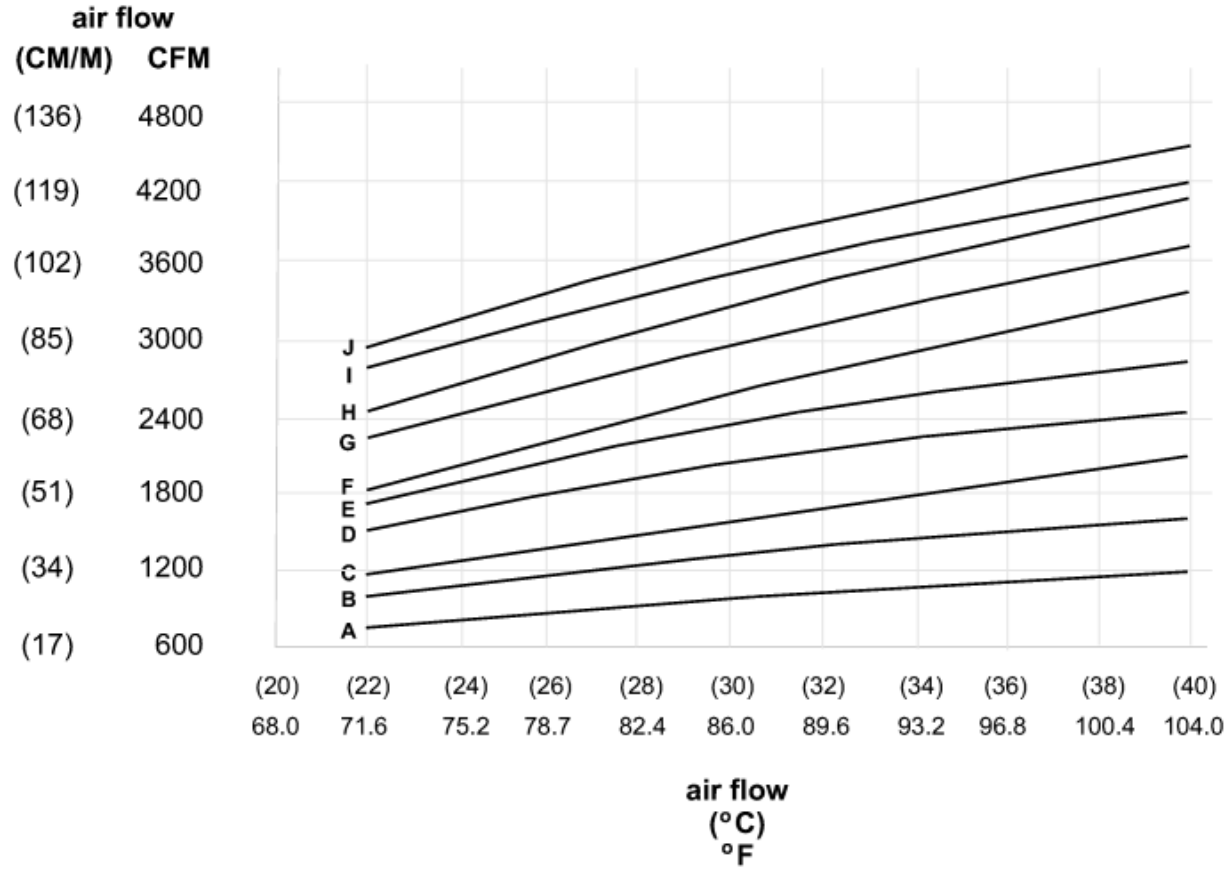


Figure 19. 3906 air flow requirements for data centers below 1500 feet elevation

Table 30. System exhaust air temperature resulting from system inlet temperature

Model	Use cooling curve[1]	22 ºC inlet	24 ºC inlet	26 ºC inlet	28 ºC inlet	30 ºC inlet	32 ºC inlet	34 ºC inlet	36 ºC inlet	38 ºC inlet	40 ºC inlet
M01/LM1 typical radiator-cooled	C	32ºC	33ºC	35ºC	36ºC	38ºC	39ºC	41ºC	42ºC	44ºC	46ºC
M01/LM1 maximum radiator-cooled	D	34ºC	35ºC	37ºC	38ºC	40ºC	41ºC	43ºC	43ºC	45ºC	47ºC
M01/LM1 typical water-cooled	A	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M01/LM1 maximum water-cooled	B	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M02/LM2 typical radiator-cooled	F	33ºC	34ºC	36ºC	37ºC	39ºC	40ºC	42ºC	43ºC	45ºC	47ºC
M02/LM2 maximum radiator-cooled	H	37ºC	37ºC	39ºC	40ºC	42ºC	43ºC	45ºC	45ºC	47ºC	49ºC
M02/LM2 typical water-cooled	C	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M02/LM2 maximum water-cooled	E	24ºC	25ºC	27ºC	29ºC	31ºC	33ºC	35ºC	37ºC	39ºC	41ºC
M03/LM3 typical radiator-cooled	H	35ºC	35ºC	37ºC	38ºC	40ºC	41ºC	43ºC	44ºC	46ºC	48ºC
M03/LM3 maximum radiator-cooled	I	39ºC	39ºC	41ºC	41ºC	43ºC	44ºC	46ºC	46ºC	48ºC	50ºC
M03/LM3 typical water-cooled	E	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M03/LM3 maximum water-cooled	F	23ºC	25ºC	27ºC	29ºC	31ºC	33ºC	35ºC	37ºC	39ºC	41ºC
M04/LM4 typical radiator-cooled	I	34ºC	35ºC	37ºC	38ºC	40ºC	41ºC	43ºC	44ºC	46ºC	48ºC
M04/LM4 maximum radiator-cooled	J	38ºC	39ºC	41ºC	41ºC	43ºC	44ºC	46ºC	47ºC	49ºC	51ºC
M04/LM4 typcial water-cooled	F	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M04/LM4 maximum water-cooled	G	23ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M05/LM5 typical radiator-cooled	I	36ºC	36ºC	38ºC	39ºC	41ºC	42ºC	44ºC	45ºC	47ºC	49ºC

Table 30. System exhaust air temperature resulting from system inlet temperature (continued)

Model	Use cooling curve[1]	22 ºC inlet	24 ºC inlet	26 ºC inlet	28 ºC inlet	30 ºC inlet	32 ºC inlet	34 ºC inlet	36 ºC inlet	38 ºC inlet	40 ºC inlet
M05/LM5 maximum radiator-cooled	J	39ºC	40ºC	42ºC	42ºC	44ºC	45ºC	47ºC	48ºC	50ºC	52ºC
M05/LM5 typical water-cooled	F	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC
M05/LM5 maximum water-cooled	G	23ºC	24ºC	26ºC	28ºC	30ºC	32ºC	34ºC	36ºC	38ºC	40ºC

Table 31. Air flow increases in three elevation ranges

Elevation range	Air flow multiplier
1,5000 to 3,000 ft	1.10
3,000 to 6,000 f6	1.25
6,000 to 10,000 ft	1.40

If water-cooled, return air temperature is typically between 23^0 C and 28^0 C depending on room ambient, room dewpoint and actual heatload.

The proportion of server heatload removed to water is affected by the local ambient, facilities water temperature, and dewpoint. For servers operating in 22^0 C to 27^0 C ambient and under 11^0 C dewpoint, water typically removes between 80% and 120% of input power. When the ambient is below 18^0 C, the small temperature difference between exhaust air and cooling water temperature lessens rear heat exchangers' effectiveness. Servers with ambient above 27^0 C are not recommended because blower speedup and warmer circuits increase server power consumption and acoustic noise.

To maintain required cooling, it may be necessary to adjust the amount of open floor tile area to achieve adequate air flow. "Cooling recommendations for the room" on page 78 shows that, for each 3906, the perforated tiles that cool that system are placed directly in front of the frame or frames, and occupy half of the aisle between system rows. Wider aisles between system rows, allowing more perforated tile area, may be necessary if your chilled air system cannot meet the air flow rate required to cool the system when the aisles are too narrow.

Beyond the specific information provided in this document, it is recommended that the customer's facility meet the general guidelines published in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers* (ASHRAE) *Handbook*.

Hot and cold aisle cooling containment

More frequently, data centers are using hot and cold aisle cooling containment solutions to help with managing airflow, eliminating hot spots and improving energy efficiency. In most cases, the 3906 system can be used within these aisle cooling containment solutions. Below are general guidelines for assessing the installation of a 3906 in a hot or cold aisle cooling containment solution.

- The 3906 with external covers is deeper than many standard racks. Care should be taken to ensure that the appropriate service clearances are maintained when the system is installed in the cooling containment solution. (See “Machine and service clearance areas” on page 74.) An optional, orderable feature code (FC 0161) defining a reduced depth set of external covers is available. The thin covers offer reduced acoustic attenuation, but a reduced front-to-rear system footprint, which helps in an aisle cooling containment solution. (See the information in Chapter 3, “Models and physical specifications,” on page 27 for cooling recommendations for the room and dimensions of the 3906 with the thin doors.)
- Installing the rear cover set with the louvers facing up should improve airflow distribution in a containment system. (See “Recommendations for the orientation of the rear covers” on page 85.)
- Consideration should be given to the type of equipment that is placed in the proximity of the 3906. The 3906 system air moving devices are typically much more capable than those in a typical server rack. Care should be taken to assure that racks across the aisle will not be negatively impacted due to their proximity to the 3906.
- Partitions used in the aisle cooling containment solution should be self-supporting and not attach to the rack for structural integrity.
- The water-cooled 3906 should not be installed in a hot aisle containment system. In many configurations, almost all of the system’s heat is rejected to building chilled water. (See “Cooling recommendations for the room” on page 78. If it is installed in a hot-aisle containment system, the cold air leaving the system would short circuit to the room air conditioning system.

If you have questions regarding the installation of the 3906 in a hot or cold aisle cooling containment solution, please consult your installation planning representative. To assist in planning for a hot and cold aisle cooling containment system, 3-D graphic files for use with computer aided design software have been made available via Resource Link .

Additionally, with the tendency for hot aisle cooling containment systems to contain warmer and warmer temperatures, service personnel working in these areas must be more cognizant of heat stress hazards and be prepared to work safely under such conditions. Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress, which is the body’s reaction to high temperatures. Preventing heat stress and being proactive about addressing its symptoms can eliminate or drastically reduce potential health risks associated with heat exposure. A common measure, the heat index, combines temperature and relative humidity to establish the human-perceived equivalent temperature, or how hot it “feels”. This measure is used frequently in public health communications and can also be applied to hot work environments. The US Department of Labor developed the OSHA Heat Safety Tool app located at the Occupational Safety and Health Administration website for both the Android and iPhone platforms. The OSHA Heat Stress Tool can be used as a screening tool to allow workers to calculate the heat index for their work site by entering the temperature (degrees F) and % humidity. Based on the calculated heat index, the app displays a risk level including protective measures that should be taken for the risk level. For IBM Service personnel wanting more information, please consult the Working in Temperature Extremes Within Data Centers website.

Recommendations for the orientation of the rear covers

The rear covers on the A frame and Z frame on the 3906 allow you to customize the direction of the airflow exiting the machine. You can direct the airflow upwards or direct the airflow downwards. (See Figure 20 on page 85.)

The ability to customize the orientation of the airflow exiting the 3906 provides you more flexibility in how to position your machines within your data center.

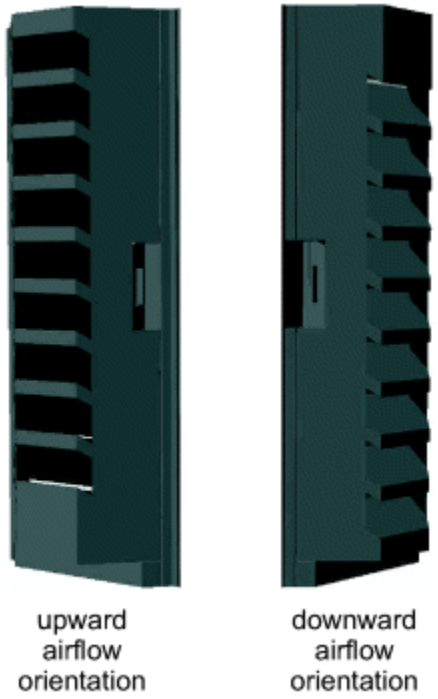


Figure 20. Rear cover airflow orientation - A frame and Z frame

Consider the following recommendations when determining the orientation of the rear covers:

- When the system is installed at either end of an aisle, the rear cover should be installed in the downward airflow orientation.
- When the system is installed in the middle of an aisle and:
  - The floor level gaps under the opposing racks are not blocked, the rear cover should be installed in the upward airflow orientation
  - The floor level gaps under opposing racks are blocked, the rear cover can be installed in either the upward airflow or downward airflow orientation
- When the system is installed in the data center with hot aisle containment, the rear cover should be installed in the upward airflow orientation.

If you have questions regarding the optimal cover orientation, please consult your installation planning representative.

Special cooling recommendations for water-cooled machine

The 3906 will require four connections to the facility water, two feeds and two returns. These connections are made using hoses that are fixed to the facility plumbing and are routed up through the rear tailgate of the machine and terminate using quick connect couplings. Hoses and a means to fasten them to the facility plumbing are provided with the server.

The 3906 operates from two fully redundant water control units (WCUs). These water control units each have their own facility feed and return water connections. If water is interrupted to one of the water control units, the other water control unit will pick up the entire load and the server will continue to operate without interruption. Therefore each water connection to the facility plumbing must be able to support the entire flow requirement for the system. In the event of water being lost to both water control units, the system will attempt to reject heat using the inner door heat exchangers in each frame and increasing system blower speeds. The server may also run in a degraded mode during this event.

Water supply

Following are some general conditions that your facility must meet prior to installation of the 3906:

- Total Hardness must not exceed 200 mg/L as calcium carbonate.
- pH must be between 7 and 9.
- Turbidity must be less than 10 NTU (Nephelometric Turbidity Unit).
- Bacteria must be less than 1000 CFUs (Colony Forming Unit)/ml.
- Water to be as free of particulate matter as feasible.
- Allowable system inlet water temperature range is 6ºC - 27ºC (43ºF - 75ºF) using standard building chilled water (BCW). A special water system for 2964 is typically not required.
- Required flow rate to the frame is 3.7 - 79.4 lpm (1 -21 gpm), depending on inlet water temperature and the number of drawers populated in the server. Colder inlet water temperatures require less flow then warmer water temperatures. Fewer drawers require less flow then maximum populated processors.
- Minimum water pressure required across the IBM hose ends is 0.34 - 2.32BAR (5 - 33.7 psi), depending on the minimum flow required.
- Maximum water pressure supplied at the IBM hose connections to the customer water supply should not exceed 6.89 BAR (100 psi).
- Table 34 on page 92, Table 35 on page 93, and Table 36 on page 94 contain reference information to help you determine the facility water supply conditions for your particular server.

Supply hoses

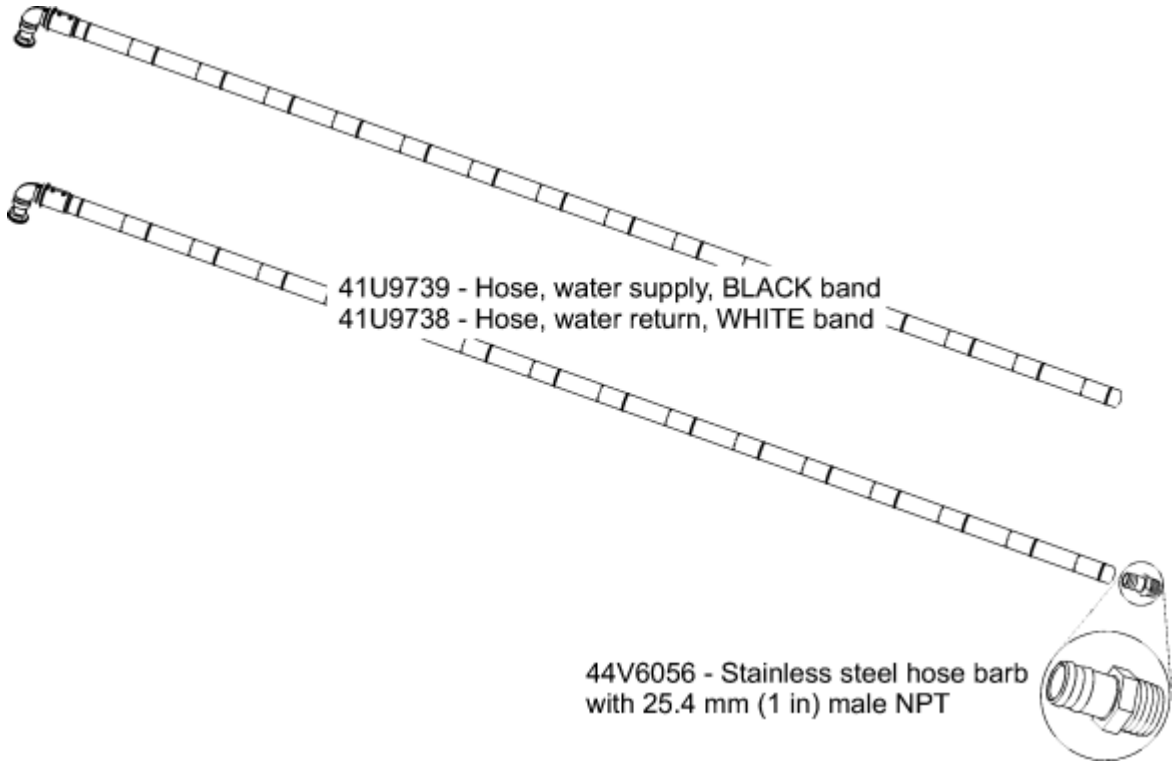
Important:
Water hoses, hose barbs, and hose clamps are shipped with the 3906 in a kit, **P/N 41U9918**. If supply hoses from a prior IBM product are being considered for reuse, it is recommended that the customer or designated plumbing installer visually inspect all hose assemblies and hose terminations for damage, leaks, wear, debris or other problems. Examples may include, but are not limited to, nicks/cuts/gouges in external insulation or outer hose jacket, loose clamps or hose joints, dirt or debris on the mating surfaces of the quick-connect couplings. If any problems are found, hose assemblies should be replaced. After three "standard product cycles" (a typical product cycle being seven years) of use, it is strongly recommended that supply hose assemblies be replaced, regardless of the condition. Contact your IBM marketing specialist or installation planner if you need specific information regarding the examination or replace of supply hoses at your facility.

Installation of these parts **is the responsibility of the customer or their designated plumbing installer** and additional materials such as plumbing fittings, valves, insulation and pipe sealant will be required. **The water hoses must be connected to the building water facility BEFORE installation of the server.** Although IBM does not make recommendations or suggestions on how to terminate the facilities side of

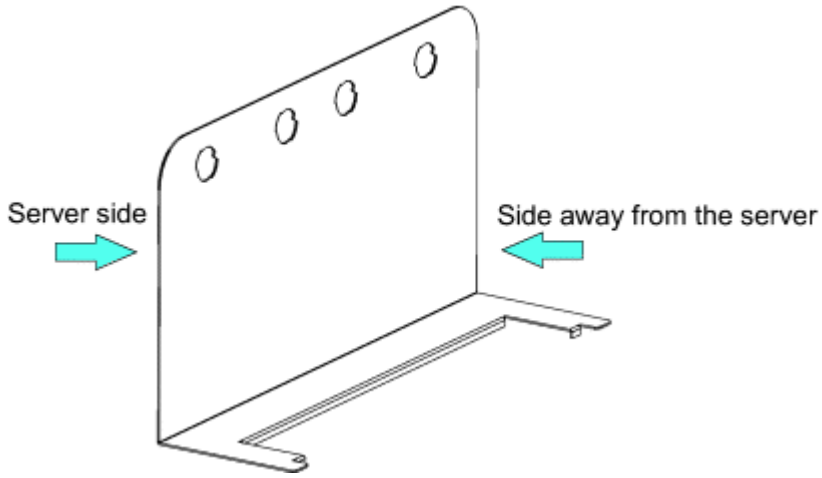
the hose, we do provide parts that we have used successfully in our installations. If you have other preferred parts or termination methods, discard the parts provided with the server.

The server installer will connect the **machine end** of the hoses to the server. The customer or facility end of the hose is left open to allow you or your designated plumbing installer to adjust the length and terminate it to the appropriate fitting on the facility plumbing. For the 3906 under-floor water supply, the following is provided:

- 2 - each 4.2 m (14 ft) hoses, (**P/N 41U9739** and 2 - hoses **P/N 41U9738**).



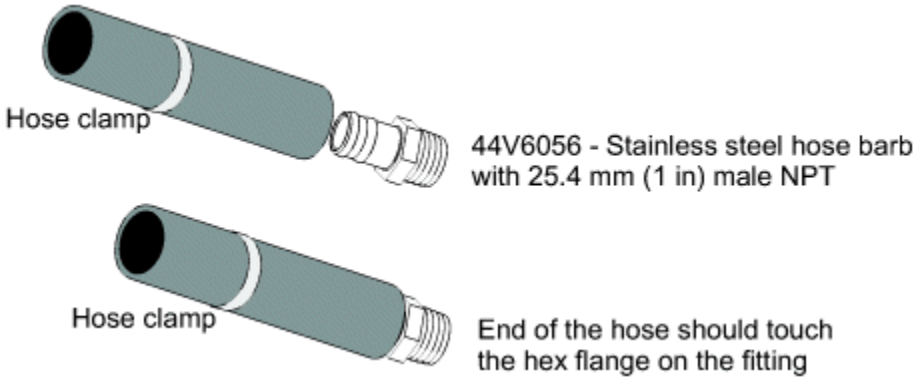
- 4 - Stainless steel hose barbs, **P/N 44V6056**.
- 1 - Locating fixture, **P/N 74Y1090**.



- 4 - spare O-rings, for Aeroquip quick connect couplings, **P/N 45D3158**.
- 6 - Oetiker hose clamps (2 are spares) **P/N 15R8650**.
- 1 - Oetiker crimping tool P/N **P/N 74Y0585** (Oetiker part number **14100082**)

For the 3906, we strongly suggest, but do not require, shutoff valves in front of the hoses, in case there is a need to remove the hoses for a service procedure or relocation.

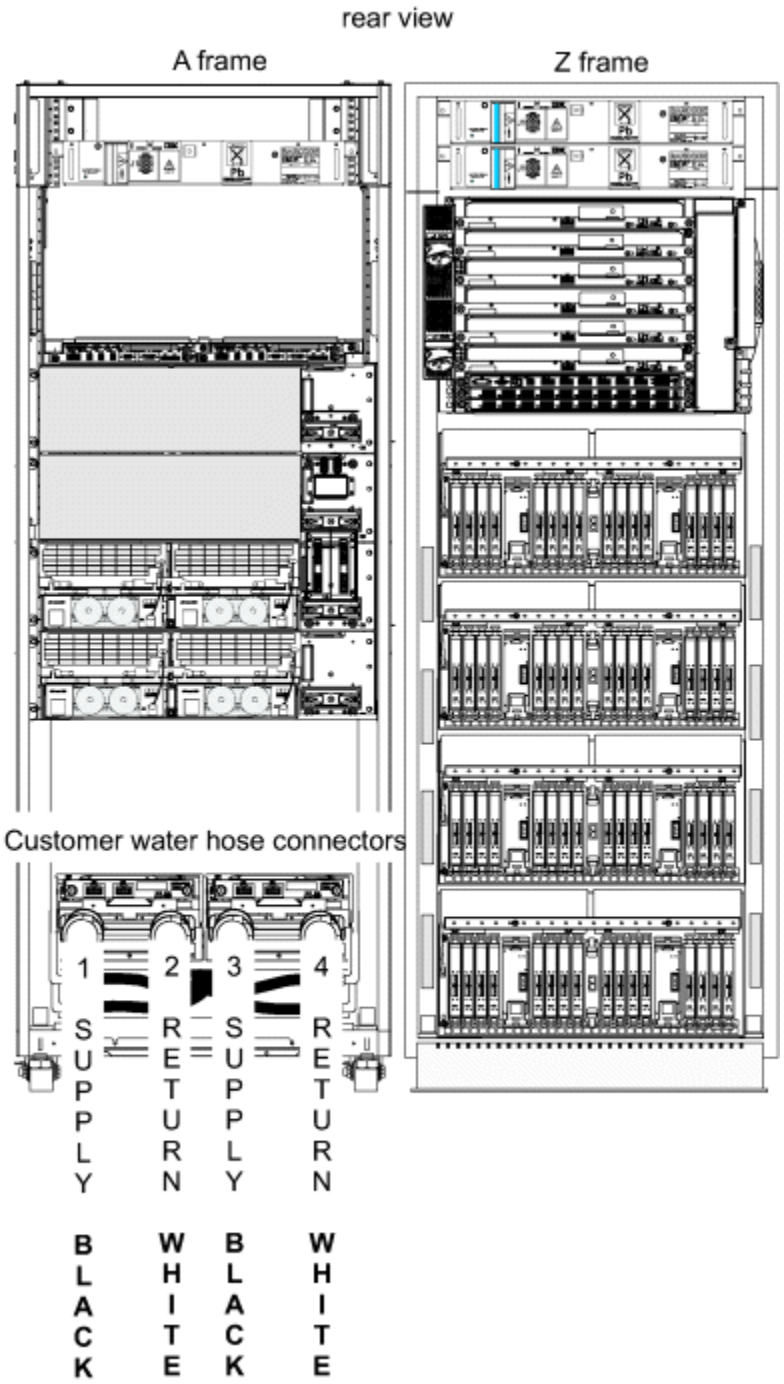
Although IBM does not make recommendations or suggestions on how to terminate the facilities side of the hose, IBM does have a released, stainless steel fitting, **P/N 44V6056**. This fitting is barbed on one side and has a 25.4 mm (1 in) male NPT on the other end which can be used to connect to your facilities. For the threaded NPT connection, IBM recommends using a thread-lock sealant (Loctite 554 creates a very reliable connection). Since the system end of the hose assembly has a 90 degree elbow, which has to be in a specified orientation, the locating fixture, **P/N 74Y1090**, provided with the system, should be used while installing the hoses . This will position the quick connects in the proper orientation, with the faces of the quick connects parallel to the rear of the frame and the correct height off the floor. If the hose barb **P/N 44V6056** is being used, a clamp such as an Oetiker **P/N 15R8650** should be used. Six of these are provided, four to be used for installation, and two are spares. The clamp should be slid over the hose loosely and then the hose should be slid onto the barb until the end of the hose touches the hex flange on the hose barb fitting.



The clamp is then to be positioned 2 to 4 mm (.08 in to .16 in) from the edge of the hose, prior to clamping. Oetiker clamping tool **P/N 74Y0585** (their part number **14100082**) must be used to crimp the clamp (the clamp is fully crimped when the gap at the base of the crimp is 3 mm (.12 in) wide, maximum). After installation of the hoses any exposed hose or plumbing fittings should be wrapped in insulation to avoid condensation forming.

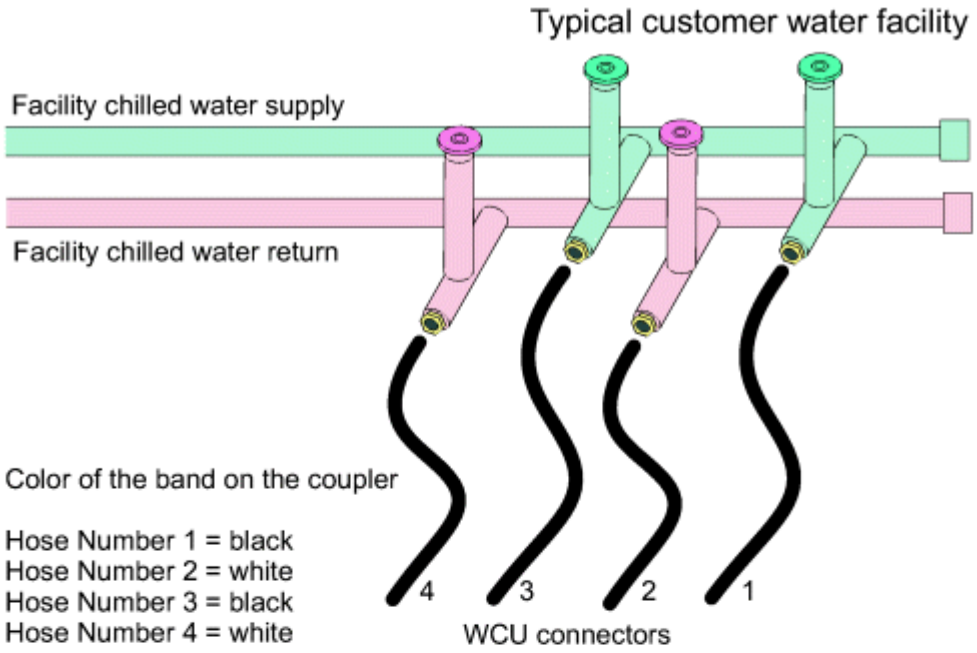
The organizer is removed after the hoses are connected to the facility water supply. Save the organizer for future use in case this server should be relocated.

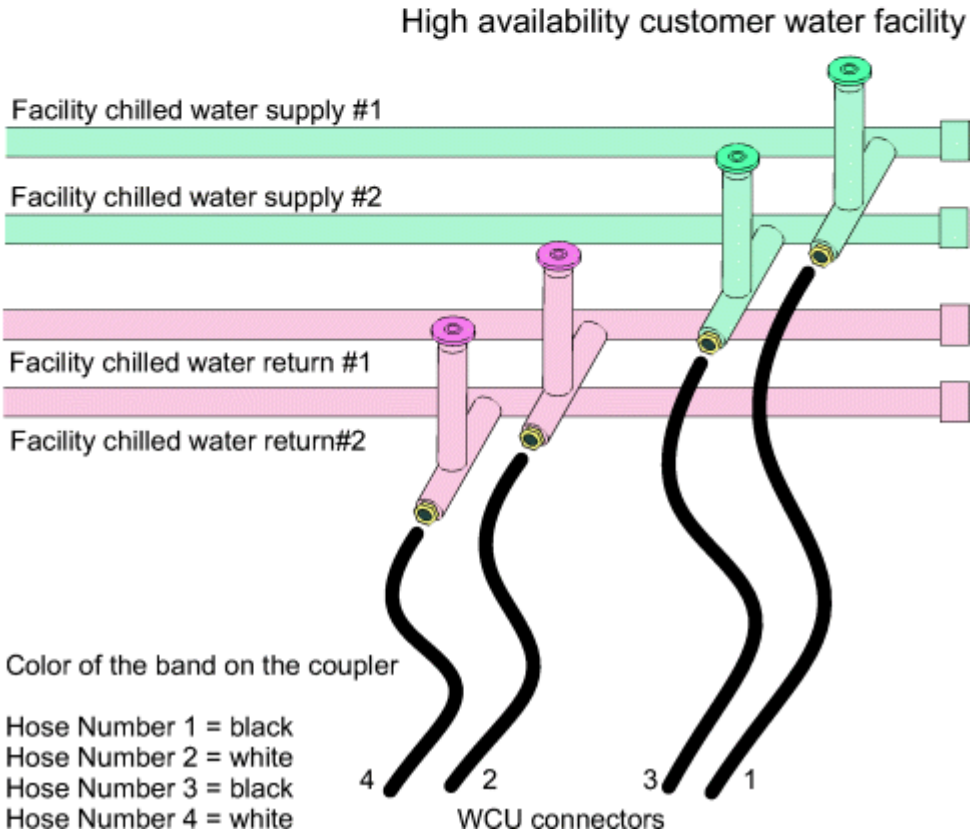
Water-cooled server hose connections, for the customer water supply, are located at the bottom rear of the A frame.



The water hoses are installed through the I/O cable tailgate at the rear of the A frame. This significantly reduces the space available for I/O cable exit from the A frame. One option to alleviate this situation is to consider routing some of the I/O cables from the rear of the A frame to the front of the frame.Another possibility is top exit I/O towers. If your facility has or is considering overhead cabling, the use of top exit I/O helps to solve the crowding of too many cables exiting the bottom of the frames.

The following illustration shows two water facilities: the upper diagram represents a typical chilled water installation where the supply and return runs are connected to a single chilled water source. To assure maximum, uninterrupted cooling, you may want to consider a high availability approach to the water supply. This would mean running a pair of supply and return lines from each of two different chilled water sources, as shown in the lower diagram. This would insure that, if one source should become unavailable, the other would continue to cool the server, with no degradation.


Typical customer water facility
Facility chilled water supply
Facility chilled water return
Color of the band on the coupler
Hose Number 1 = black
Hose Number 2 = white
Hose Number 3 = black
Hose Number 4 = white
4
3
2
1
WCU connectors


High availability customer water facility
Facility chilled water supply #1
Facility chilled water supply #2
Facility chilled water return #1
Facility chilled water return#2
Color of the band on the coupler
Hose Number 1 = black
Hose Number 2 = white
Hose Number 3 = black
Hose Number 4 = white
4
2
3
1
WCU connectors

Materials used in the water cooling units

The customer side of the 3906 water cooling unit is comprised of the following material set. Any chemicals that are added to the customer's chilled water must be compatible with the following materials.

Table 32. WCU materials

Description	**Material**
Heat exchanger - plates	Stainless steel
Heat exchanger - braze material	Copper
Heat exchanger - hose barbs	Stainless steel
Pipes and fittings - inlet and outlet pipes	Stainless steel (alternate - copper)
Pipes and fittings - threaded fittings	Copper
Pipes and fittings - jog	Aluminum bronze alloy
Quick Connects - body castings	Stainless steel
Quick Connects - external O-ring	EPR (Ethylene Propylene Rubber)
Quick Connects - internal gaskets	EPR (Ethylene Propylene Rubber)
Control valve - stem	Stainless steel
Control valve - disc gasket	Teflon
Control valve - body (tee)	Red brass
Control valve - seat	Bronze
Thread sealant - adhesive	Loctite 554 (red)

Table 33. Water hose materials

Description	**Material**
Aeroquip quick-connect - C-ring	EPR (Ethylene Propylene Rubber)
Aeroquip quick-connect - body	Stainless steel
Aeroquip quick-connect - ball	Stainless steel
Aeroquip quick-connect - fitting O-ring	Teflon
Aeroquip quick-connect - face seal	EPR (Ethylene Propylene Rubber)
Aeroquip quick-connect - plastic face seal	Polycarbonate (does not touch water)
Pig tail casting	Aluminum bronze alloy
Pig tail hose - cover	Carboxylated nitrile
Pig tail hose - reinforcement	Synthetic, high tensile textile cord
Pig tail hose - tube	Nitrile

Water specifications

The following tables provide the requirements for the chilled water at the server connection.

Table 34. Required building chilled water conditions - (6^0 C - 13^0 C)

Machine model	Max heat load to water (kw)	Chilled water per Water Conditioning Unit (water-cooled)	Building chilled water inlet temperature (^{0} C)							
			6^0	7^0	8^0	9^0	10^0	11^0	12^0	13^0
M01/LM1	9.5	**Flow (LPM)**	10	10.5	11	12	13	15	17	19
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
		Outlet temp ^{0} C	23	23	23	23	23	23	22	22
M02/LM2	17.5	**Flow (LPM)**	15	17	18	20	22	24	27	30
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.37
		Outlet temp ^{0} C	23	22	22	22	22	22	22	21
M03/LM3	21.5	**Flow (LPM)**	20	21	23	26	28	31	34	39
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.36	0.38	0.46	0.60
		Outlet temp ^{0} C	22	22	21	21	21	21	21	21
M04/LM4	25.5	**Flow (LPM)**	25.5	27	30	33	36	40	44	44
		Pressure Drop (Bar)	0.34	0.35	0.37	0.43	0.53	0.63	0.76	0.76
		Outlet temp ^{0} C	21	21	21	21	21	21	21	22
M05/LM5	27	**Flow (LPM)**	25.5	27	30	33	36	40	44	44
		Pressure Drop (Bar)	0.34	0.35	0.37	0.43	0.53	0.63	0.76	0.76
		Outlet temp ^{0} C	21	21	21	21	21	21	21	22

Notes:

1. Units are liters/minute, bars, and ^{0}C. These conditions must be available to each of the water conditioning units.
2. Temperature of water out of WCU that cools the server is dependent on measured dew point as well as building water temperature. SCM performance is unaffected as long as dew point does not exceed 24^{0}C and building water does not exceed 27^{0}C. However, the amount of heat removed by rear of frame heat exchangers is reduced in more humid environments or in cases with warm building chilled water. If building chilled water exceeds 27^{0}C or room dew point exceeds 24^{0}C, the water to server temperature will continue to rise and at some point may lower processor frequency.

Table 35. Required building chilled water conditions - (14^0 C - 20^0 C)

Machine model	Max heat load to water (kw)	Chilled water per Water Conditioning Unit (water-cooled)	Building chilled water inlet temperature ^{0} C						
			14^0	**15^0**	**16^0**	**17^0**	**18^0**	**19^0**	**20^0**
M01/LM1	9.5	**Flow (LPM)**	23	27	34	40	40	40	40
		Pressure Drop (Bar)	0.34	0.35	0.47	0.63	0.63	0.63	0.63
		Outlet temp ^{0} C	21	21	21	21	22	23	24
M02/LM2	17.5	**Flow (LPM)**	36	43	43	43	43	54	54
		Pressure Drop (Bar)	0.52	0.73	0.73	0.73	0.73	1.15	1.15
		Outlet temp ^{0} C	21	21	22	23	24	24	25
M03/LM3	21.5	**Flow (LPM)**	39	39	45	45	52	52	52
		Pressure Drop (Bar)	0.60	0.60	0.8	0.8	1.05	1.05	1.05
		Outlet temp ^{0} C	22	23	23	24	24	25	26
M04/LM4	25.5	**Flow (LPM)**	47	47	47	55	55	60	60
		Pressure Drop (Bar)	0.88	0.88	0.88	1.2	1.2	1.45	1.45
		Outlet temp ^{0} C	22	23	24	24	25	25	26
M05/LM5	27	**Flow (LPM)**	47	47	47	55	55	60	60
		Pressure Drop (Bar)	0.88	0.88	0.88	1.2	1.2	1.45	1.45
		Outlet temp ^{0} C	22	23	24	24	25	25	26

Notes:

1. Units are liters/minute, bars, and ^{0}C. These conditions must be available to each of the water conditioning units.
2. Temperature of water out of WCU that cools the server is dependent on measured dew point as well as building water temperature. SCM performance is unaffected as long as dew point does not exceed 24^{0}C and building water does not exceed 27^{0}C. However, the amount of heat removed by rear of frame heat exchangers is reduced in more humid environments or in cases with warm building chilled water. If building chilled water exceeds 27^{0}C or room dew point exceeds 24^{0}C, the water to server temperature will continue to rise and at some point may lower processor frequency.

Table 36. Required building chilled water conditions - (21^0 C - 27^0 C)

Machine model	Max heat load to water (kw)	Chilled water per Water Conditioning Unit (water-cooled)	Building chilled water in ^{0} C						
			21^0	**22^0**	**23^0**	**24^0**	**25^0**	**26^0**	**27^0**
M01/LM1	9.5	**Flow (LPM)**	40	40	55	55	60	60	60
		Pressure Drop (Bar)	0.63	0.63	1.2	1.2	1.45	1.45	1.45
		Outlet temp ^{0} C	25	26	26	27	27	28	29
M02/LM2	17.5	**Flow (LPM)**	54	54	60	60	60	65	65
		Pressure Drop (Bar)	1.15	1.15	1.45	1.45	1.45	1.65	1.65
		Outlet temp ^{0} C	26	27	27	28	29	30	31
M03/LM3	21.5	**Flow (LPM)**	52	52	60	60	65	65	70
		Pressure Drop (Bar)	1.05	1.05	1.45	1.45	1.65	1.65	1.9
		Outlet temp ^{0} C	27	28	28	29	30	31	31
M04/LM4	25.5	**Flow (LPM)**	60	60	60	60	65	70	70
		Pressure Drop (Bar)	1.45	1.45	1.45	1.45	1.65	1.9	1.9
		Outlet temp ^{0} C	27	28	29	30	31	31	32
M05/LM5	27	**Flow (LPM)**	60	60	60	60	65	70	70
		Pressure Drop (Bar)	1.45	1.45	1.45	1.45	1.65	1.9	1.9
		Outlet temp ^{0} C	27	28	29	30	31	32	33

Notes:

1. Units are liters/minute, bars, and ^{0}C. These conditions must be available to each of the water conditioning units.
2. Temperature of water out of WCU that cools the server is dependent on measured dew point as well as building water temperature. SCM performance is unaffected as long as dew point does not exceed 24^{0}C and building water does not exceed 27^{0}C. However, the amount of heat removed by rear of frame heat exchangers is reduced in more humid environments or in cases with warm building chilled water. If building chilled water exceeds 27^{0}C or room dew point exceeds 24^{0}C, the water to server temperature will continue to rise and at some point may lower processor frequency.

Attention:
IBM will supply and use a deionized (DI) water solution that is mixed with benzotriazole (BTA), a corrosion inhibitor, for use within the system side cooling loop of water cooled products. BTA is mixed with the deionized water to a concentration of approximately 990 parts per million by weight. The customer must dispose of the water solution in accordance with applicable laws and regulations and product characteristics at the time of disposal.

The Service Support Representative (SSR) will fill or drain the system of this solution as required for an install, uninstall, or some maintenance procedures, such as a drawer replace. The Fill and Drain kit and water container should be stored where the SSR can readily access it as needed, and it should be stored in a climate controlled environment with the other system service tools and equipments needed to install, service, relocate, or discontinue a system. The Fill and Drain kit is used for a water-cooled system or a radiator-cooled system. The water container holds 15.5 – 16.0 liters (4 gallons) of deionized water mixed with a concentration of 0.099% (900-990 ppm) of Benzotriazole (BTA) by weight.

For detection and location reporting of potential fluid leaks, there are leak detection systems you can use beneath a raised floor. These systems are generally used to detect leaks from glycol, condenser water, and chilled water cooling piping, humidification feed water piping. If desired, these sensor detection systems can be used to monitor for potential product leaks, such as the BTA water solution, which is 99.9% deionized water.

Glycol will lower the thermal efficiency of heat exchangers. Its effect will vary by concentration and possibly heatload. Tables provided in this documentation show how much building chilled water to supply versus configuration for chilled water **without** glycol. Customers should be aware that glycol has a diluting effect on heat transfer properties versus pure water. That means if used in a rear door heat exchanger, less heat will be removed from the exit air and, when used to cool the 3906 WCU, the flow rate must be increased when glycol is added. For example, adding 20% ethylene glycol to the building water supply will require a 10% increase in the flow rate to maintain the same cooling level as a 0% ethylene glycol water supply. Adding 40% ethylene glycol to the building water supply will require a 30% increase in the flow rate to maintain the same cooling level as a 0% ethylene glycol water supply.

Contact your IBM marketing specialist or installation planner if you need specific information regarding the use of glycol in your facility.

Considerations for multiple system installations

When integrating a 3906 into an existing multiple-system environment, or when adding additional systems to an installed 3906, consider the following factors:

- **Thermal interactions**

  Although computer room floor space is valuable, for optimal cooling, it is recommended that 3906 servers have a 1168.4 mm (46 in) aisle between rows of systems to reduce surrounding air temperature. See “Cooling recommendations for the room” on page 78.

- **Floor placement**

  The 3906 must be precisely placed for the cable openings to match the floor cutouts. There is zero tolerance for variance from the frame positioning in relation to the floor tiles.

- **Floor loading**

  When trying to optimize floor space utilization, floor loading weight distribution rules may be inadvertently violated by overlapping weight distribution areas of adjacent machines. Obtain the services of a qualified structural engineer if you are uncertain of the floor load assessment for your computer room.

Chapter 4. Guide for raised floor preparation

This chapter provides recommendations and requirements for making the necessary openings in the raised floor for installation.

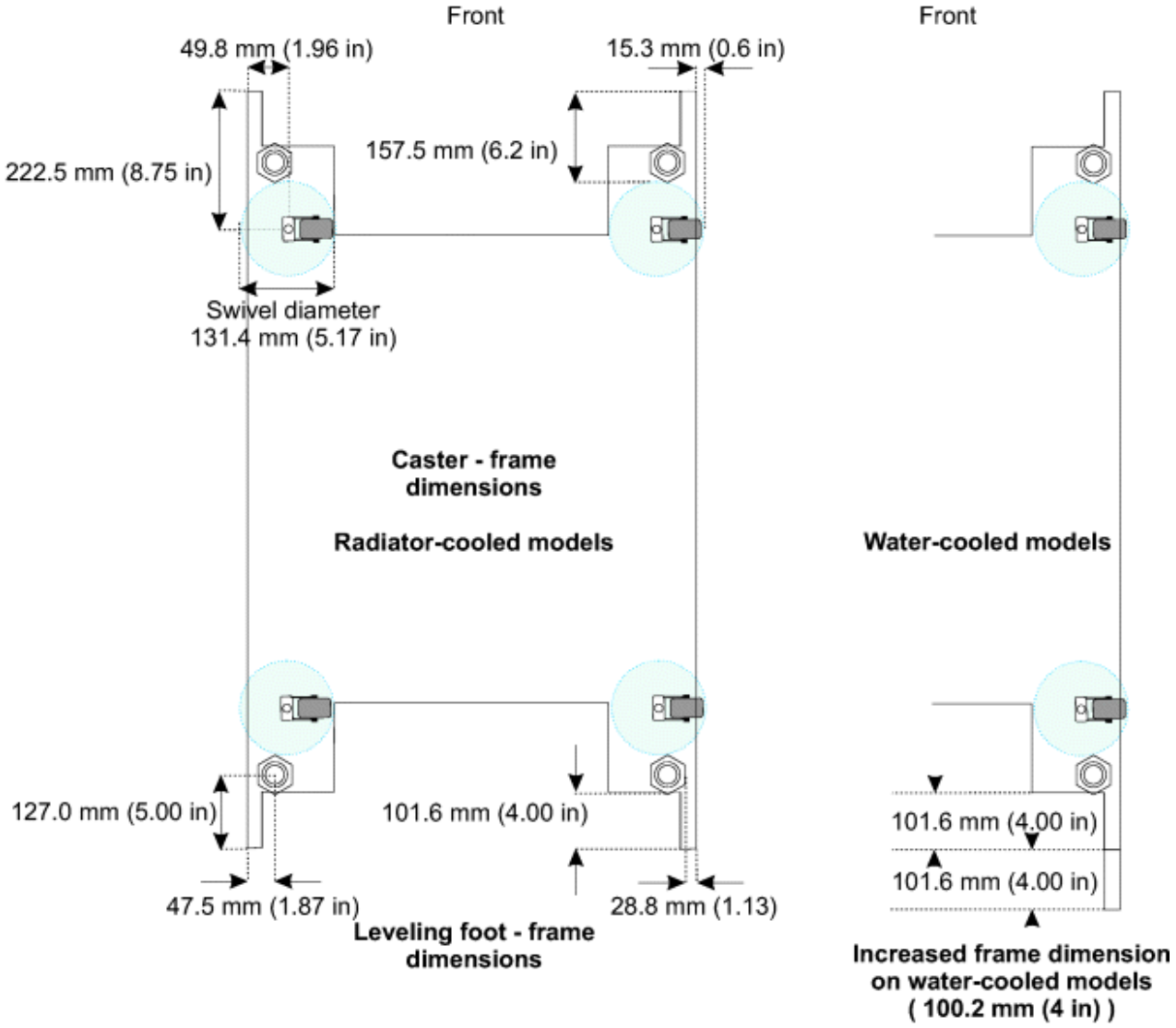
The drawings on the following pages are intended only to show relative positions and accurate dimensions of floor cutouts. They are **not** machine templates and are **not** drawn to scale.

Raised floor cutouts should be protected by electrically non conductive molding, appropriately sized, with edges treated to prevent cable damage and to prevent casters from rolling into the floor cutouts.

Note: For a water-cooled model on a raised floor, the height of the raised floor (subfloor to top surface of floor tile) must be a minimum of 228.6 mm 9 inches) to accommodate the bend radius of the water hoses.

Casters

The following illustration shows the physical dimensions around the casters. When planning for both the movement and positioning of the system, be aware that each caster swivels in a circle slightly larger than 129.6 mm (5.1 in) in diameter. Exercise caution when working around floor cutouts.



Procedure for cutting and placement of floor panels

Important:

The 3906 , fully configured, can weigh in excess of 2903.45 kg (6401 lb). **You must be certain that the raised floor on which you are going to install the server is capable of supporting this weight.** Contact your floor tile manufacturer and a structural engineer to verify that your raised floor is safe to support the 3906 .

Depending on the floor panel type, additional panel supports (pedestals) may be necessary to maintain the structural integrity of an uncut panel, or to restore the integrity of a cut floor panel. Consult the panel manufacturer and the structural engineer to ensure that the panel can sustain the concentrated loads.

Ensure adequate floor space is available to place the frames over the floor panels exactly as shown on the drawing.

DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

__ 1. Identify the panels needed, and list the total quantity of each panel required for the installation.

__ 2. Cut the required quantity of panels. **Panels A1, A4, C1, and C4 are optional.** If you have existing equipment already installed over these panels, you do not have to cut them.

__ 3. Additional panel supports (pedestals) are **recommended** to restore the structural integrity of the cut floor tile panels.

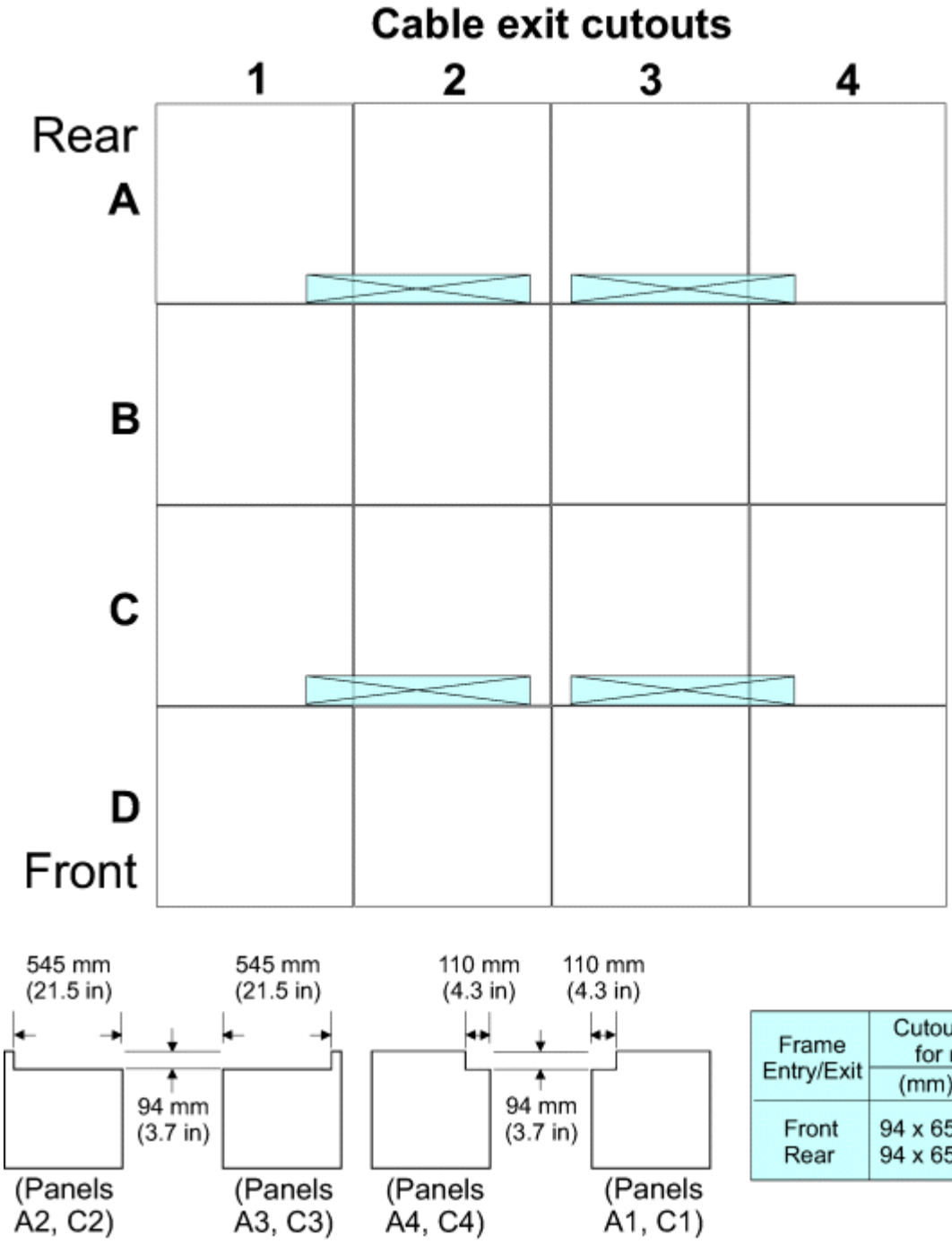
__ 4. When cutting the panels, you must adjust the size of the cut for the thickness of the edge molding you are using. The dimensions shown are finished dimensions.

__ 5. For ease of installation, number each panel as it is cut as shown on the panel specification pages.

__ 6. Use the raised floor diagram to install the panels in the proper positions.

__ 7. You will need as many as eight **uncut** floor tiles to temporarily replace A1 through A4 and C1 through C4 during the physical placement of the frames. After frame placement, the uncut tiles can be removed and the cut tiles for A1 through A4 replaced in the floor.

Raised floor with 610 mm (24 in) or 600 mm (23.5 in) floor panels



Frame Entry/Exit	Cutout dimensions for raised floor	
	(mm)	(in)
Front	94 x 655	3.7 x 25.8
Rear	94 x 655	3.7 x 25.8

Figure 21. Raised floor with floor panels

Important:

Extra pedestals may be placed as shown in Figure 22 on page 101:

1. Pedestals **Bp1, Bp2, Bp3, Bp4, Cp1, Cp3, Cp4, and Cp6** may be placed approximately **under each caster position** to prevent floor tile panels from sagging.
2. Pedestals **Cp2** and **Cp5** may be used to support the cut corners of floor tiles **C2** and **C3**.
3. Pedestals **Ap1, Ap2, Ap3, Ap4, Ap5, and Ap6** may be used to support the cut corners of floor tiles **A1, A2, A3 and A4.** Although these four tiles are not load-bearing, equipment, moving in the row where these floor panels sit, may place high loads momentarily on the tiles.
4. If you are using either the frame tie-down features (**FC 8003** or **FC 8004**), you may want to place additional pedestals under the bars that rest on the floor tile panels after the features have been installed.

All of these extra pedestals are recommendations. You must decide which, if any, of these recommendations to use.

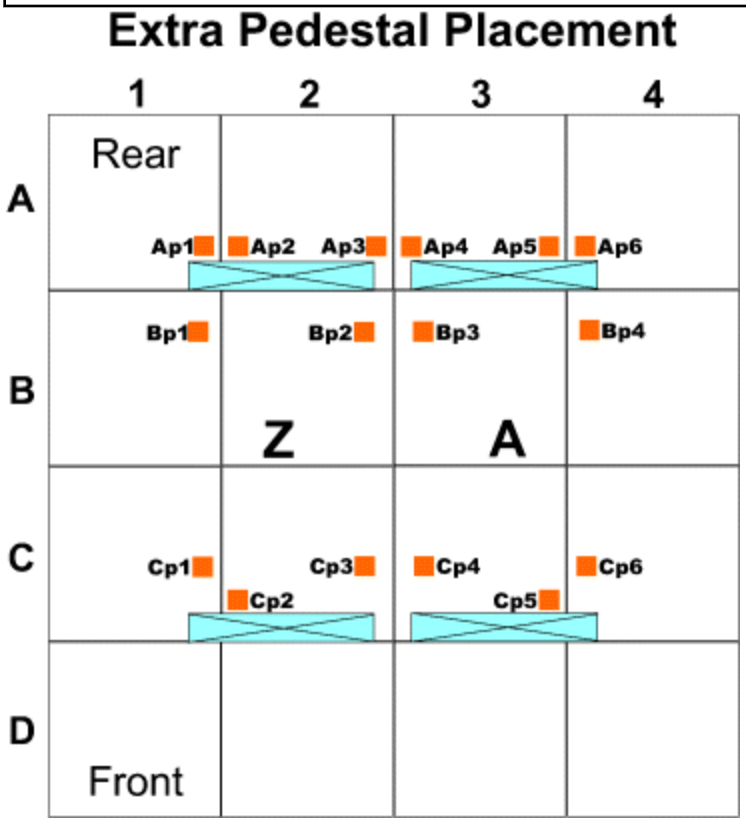


Figure 22. Extra pedestal placement

All pedestals should be adjusted to just contact the underside of each floor panel **before** the frames are rolled into place. Depending on your floor panel type, additional supports (pedestals) may be necessary to restore the structural integrity of cut panels.

Chapter 5. Power requirements

The 3906 requires the following:

- System frame
  - 50/60 Hz AC or high voltage DC
  - Voltage ranges:
    - AC: 200V to 480V AC, three-phase wiring
    - DC: 380V to 520V DC

  The system requires either:

  - **For configurations using a total of six or less Bulk Power Regulators (BPRs)** - **Two** power feeds, of the types previously described, each with the same nominal voltage. One is connected to the front of the Z frame, and one is connected to the rear of the Z frame.

  or

  - **For all other configurations** - **Four** power feeds, of the types previously described, each with the same nominal voltage. Two are connected to the front of the Z frame, and two are connected to the rear of the Z frame.

  There are no power feeds to the A frame.

  You cannot use a mix of DC power and AC power. The input power for the 3906 must be exclusively AC or exclusively DC.

  Refer to the Appendix C, “3-phase dual power installation,” on page 183 for the correct wiring method for your particular power distribution equipment.

  Read the following information about **Plan Ahead** feature codes.

  - If you choose a server that requires only two power cords, but want to be prepared for future growth, you may order the Line Cord Plan Ahead feature (FC 2000), which ships **all four line cords** regardless of the number of BPRs.
  - If you expect that your server may eventually be adding additional processors or PCIe I/O drawers, you may want to consider the Balanced Power Plan Ahead feature (FC 3003), which adds the **maximum number of Bulk Power Regulators (BPRs)** to your server's power supplies. A fully-configured server uses twelve BPRs. So, for example, if your server configuration would only require six BPRs, the Balanced Power feature would add six more BPRs to maximize available power. If not already included in your order, the Line Cord Plan Ahead feature would also automatically be added along with Balanced Power. Finally, if your server is going to use the Internal Battery Feature (IBF) (FC 3216), Balanced Power Plan Ahead will automatically supply the maximum number of batteries, **six IBFs**, with your server.
  - Balanced Power Plan Ahead (FC 3003) does not apply to servers using the DC power cord option.
  - The Balanced Power and Line Cord Plan Ahead features give you the chance to eliminate future service downtime when upgrading your server.
- Hardware Management Console

  For HMC FC 0092, a single-phase feed from a customer-supplied service outlet. The outlet must provide 100V to 130V or 200V to 240V 50/60 Hz single-phase AC power.

  For HMC FC 0095 and HMC FC 0082, a single-phase feed from a customer-supplied service outlet. The outlet must provide 90 Vrms to 137 Vrms or 180 Vrms to 265 Vrms 47/63 Hz single-phase AC power.

  For HMC FC 0094, HMC FC 0096, and HMC FC 0083, the customer must supply a PDU that provides C13 outlets for the three C13/C14 power jumper cables.

Power installation considerations

The 3906 operates from two fully-redundant power supplies. These redundant power supplies each have their own line cords, or pair of line cords, allowing the system to survive the loss of customer power to either line cord or line cord pair. If power is interrupted to one of the power supplies, the other power supply will pick up the entire load and the system will continue to operate without interruption. Therefore, the line cord(s) for each power supply must be wired to support the entire power load of the system.

Note: The power cord set(s) provided are for use only with this product.

For the most reliable availability, the line cords in the front (A) and the rear (B) of the Z frame should be powered from different PDUs. The A line cord or cords exit the front of the Z frame and should be connected to one PDU. The B line cord or cords exit the rear of the Z frame and should be connected to a different PDU than the A cord or cords.

See Appendix C, “3-phase dual power installation,” on page 183 for examples of typical redundant wiring facilities.

The power supplies at the front end of the system use active resistive load synthesis. Harmonic distortion of the current waveform is small enough that it need not be considered in planning the installation. The power factor is typically 0.95 or higher.

The utility current distribution across the phase conductors (phase current balance) depends on the system configuration. Each front end power supply is provided with phase switching redundancy. The loss of an input phase is detected and the total input current is switched to the remaining phase pair without any power interruption. Depending on the configuration input power draw, the system can run from several minutes to indefinitely in this condition. Because most single phase losses are transients which recover in seconds, this redundancy provides protection against virtually all single phase outages.

Supply type	Nominal voltage range (V)	Voltage tolerance (V)	Frequency range (Hz)
Two or four redundant 3-phase line cords	200-480	180-508	50-60
Two or four redundant DC line cords	380-520	350-550	N/A

Source type	Frequency	Input voltage range (V)	Rated input current (A)
Three-phase (60A plug)	50/60 Hz	200V [1]	50A
Three-phase (60A plug)	50/60 Hz	208V - 240V [2]	48A
Three-phase (30A plug)	50/60 Hz	380V - 415V [3]	24A
Three-phase (30A plug)	60 Hz	480V [4]	20A
Three-phase (63A no plug)	50/60 Hz	220V - 240V	48A
Three-phase (32A no plug)	50/60 Hz	380V - 415V	25A
DC	N/A	380V - 520V	44A

Notes:

1. Japan (same physical cord as Note 2)
2. US, Canada (same physical cord as Note 1)
3. US, Canada only
4. US only

Line cord/bulk power regulator (BPR) specifications

The following tables provide number of line cords and number of BPRs required based on the number of processor drawers and number of PCIe I/O drawers in the server configurations.

Table 37. Number of line cords required per side

	Number of PCIe I/O drawers					
	0	**1**	**2**	**3**	**4**	**5**
M01 or LM1 **(1 processor drawer)**	1	1	1	1	1	1
M02 or LM2 **(2 processor drawers)**	1	1	1	1	1	2
M03 or LM3 **(3 processor drawers)**	1	1	2	2	2	2
M04 or LM4 **(4 processor drawers)**	2	2	2	2	2	2
M05 or LM5 **(4 processor drawers)**	2	2	2	2	2	2

Table 38. Number of BPRs installed per side

	Number of PCIe I/O drawers [3]					
	0	**1**	**2**	**3**	**4**	**5**
M01 or LM1 **(1 processor drawer)**	2 [1]	2 [1]	2 [1]	2 [1]	N/A	N/A
M02 or LM2 **(2 processor drawers)**	2 [1]	3 [1]	3 [1]	3 [1]	3 [1]	4 [2]
M03 or LM3 **(3 processor drawers)**	3 [1]	3 [1]	4 [2]	4 [2]	4 [2]	5 [2]
M04 or LM4 **(4 processor drawers)**	4 [2]	4 [2]	5 [2]	5 [2]	5 [2]	6 [2]
M05 or LM5 **(4 processor drawers)**	4 [2]	4 [2]	5 [2]	5 [2]	5 [2]	6 [2]

Notes:

1. Single-line power cord pair.
2. Two-line power cord pair.
3. Current balance on the phases is determined by the BPR count in this table. The balance (or imbalance) is defined in Table 39 on page 106.

Table 39. Current balance per line cord

	1st cord set	2nd cord set
2 BPRs/side	unbalanced B [2]	—
3 BPRs/side	balanced [3]	—
4 BPRs/side	balanced	unbalanced A [1]
5 BPRs/side	balanced	unbalanced B
6 BPRs/side	balanced	balanced

Note:

1. Unbalanced A - only two phases carry equal current. The third phase carries zero.
2. Unbalanced B - two phases carry equal current. The third phase carries 1.73 times the current carried by the other two.
3. Balanced - all phases carry the same current.

Table 40. Current balance example (M01 or LM1)

Example 1 - Model M01 or LM1 with 1 PCIe I/O drawer
From Table 38 on page 105, the number of BPRs per side = 2
From Table 39 on page 106, the phase currents are unbalanced B on the first line cord set (there is no second line cord set.)

Table 41. Current balance example (M02 or LM2)

Example 2 - Model M02 or LM2 with 4 PCIe I/O drawers
From Table 38 on page 105, the number of BPRs per side = 3
From Table 39 on page 106, the phase currents are balanced on the first line cord set (there is no second line cord set.)

Table 42. Current balance example (M03 or LM3)

Example 3 - Model M03 or LM3 with 3 PCIe I/O drawers
From Table 38 on page 105, the number of BPRs per side = 4
From Table 39 on page 106, the phase currents are balanced on the first line cord set. The phase currents are unbalanced A on the second line cord set.

Table 43. Current balance example (M04 or LM4)

Example 4 - Model M04 or LM4 with 4 PCIe I/O drawers
From Table 38 on page 105, the number of BPRs per side = 5
From Table 39 on page 106, the phase currents are balanced on the first line cord set. The phase currents are unbalanced B on the second line cord set.

Table 44. Current balance example (M05 or LM5)

Example 5 - Model M05 or LM5 with 5 PCIe I/O drawers
From Table 38 on page 105, the number of BPRs per side = 6

Table 44. Current balance example (M05 or LM5) (continued)
Example 5 - Model M05 or LM5 with 5 PCIe I/O drawers
From Table 39 on page 106, the phase currents are balanced on the first line cord set. The phase currents are balanced on the second line cord set.

Power specifications

The following tables provide system power consumption/heat load based on the number of processor drawers and number of I/O units in the server configurations. The data is shown for servers at an altitude greater than 3000 feet above sea level.

Real customer configurations will come out lower in the power estimator than the numbers in the table because the table numbers represent the maximum possible configuration which is unrealistic for an actual system. In addition, a warm room is assumed, which results in higher fan power, hopefully not the normal situation for most installations. Finally, the numbers below assume that batteries are present and charging.

Note: Power will be somewhat lower for DC input voltage.

Table 45. System power consumption - Radiator-cooled

	Number of PCIe I/O drawers					
	0	**1**	**2**	**3**	**4**	**5**
Utility power - 1 processor drawer (M01 or LM1)	6.1	7.8	9.5	10.4	N/A	N/A
Utility power - 2 processor drawers (M02 or LM2)	10.4	12.2	13.9	15.5	17.2	18.9
Utility power - 3 processor drawers (M03 or LM3)	14.7	16.5	18.3	19.9	21.5	23.2
Utility power - 4 processor drawers (41 PUs) (M04 or LM4)	19.7	21.5	23.2	24.9	26.5	28.2
Utility power - 4 processor drawers (54 PUs) (M05 or LM5)	21.4	23.1	24.9	26.5	28.1	29.8

Note:

1. Assumes maximum supported configuration (maximum I/O features installed)
2. The power factor is approximately unity.
3. Input power (kVA) equals heat output (kW).
4. For heat output expressed in kBTU per hour, multiply table entries by 3.41.
5. See Appendix C, “3-phase dual power installation,” on page 183 for recommendations on utility connections which better balance the current for installations where multiple systems are connected to the same power panel.

Table 46. System power consumption - Water-cooled

	Number of PCIe I/O drawers					
	0	**1**	**2**	**3**	**4**	**5**
Utility power - 1 processor drawer (M01 or LM1)	5.7	7.4	9.1	10.0	N/A	N/A
Utility power - 2 processor drawers (M02 or LM2)	9.6	11.5	13.2	14.8	16.4	18.1
Utility power - 3 processor drawers (M03 or LM3)	13.7	15.5	17.2	18.8	20.5	22.2
Utility power - 4 processor drawers (41 PUs) (M04 or LM4)	17.8	19.6	21.3	23.0	24.6	26.3
Utility power - 4 processor drawers (54 PUs) (M05 or LM5)	19.3	21.1	22.9	24.5	26.1	27.8

Note:

1. Assumes maximum supported configuration (maximum I/O features installed)
2. Input power (kVA) equals heat output (kW).
3. For heat output expressed in kBTU per hour, multiply table entries by 3.4.
4. See Appendix C, “3-phase dual power installation,” on page 183 for recommendations on utility connections which better balance the current for installations where multiple systems are connected to the same power panel.
5. The power advantage from using water cooling increases with the size of the system.

Power estimation tool

The power estimator tool for the 3906 allows you to enter your precise server configuration to produce an estimate of power consumption. In addition, the tool now can produce an estimate of the weight of your machine.

Log on to Resource Link at *http://www.ibm.com/servers/resourcelink*. Navigate to **Tools**, then to **Power and weight estimation**. Select your machine. Specify the quantity for the features that are installed in your machine. This tool estimates the power consumption for the specified configuration. The tool does not verify that the specified configuration can be physically built.

Note: The exact power consumption for your machine will vary. The object of the tool is produce an estimation of the power requirements to aid you in planning for your machine installation.

Actual power consumption after installation can be confirmed using the HMC **Monitors Dashboard** task.

Power capping

The 3906 supports power capping, which gives the customer the ability to limit the maximum power consumption and reduce cooling requirements. To use power capping, Automate Firmware Suite (FC 0020) must be ordered. This feature is used to enable the Automate suite of functionality associated with the IBM z Unified Resource Manager. The Automate suite includes representation of resources in a workload context, goal-oriented monitoring and management of resources, and energy management. The Automate suite is included in the base zCPC at no charge for CPs, and zIIPs.

Customer circuit breakers

The following table shows the maximum circuit breaker ratings based on input voltage.

Input voltage range (V)	System rated current (A)	Circuit breaker
200 VAC	50A	63A Japan
208 - 240 VAC	48A	60A/63A W/T
380 - 415 VAC	25A	32A W/T
380 - 415 VAC	24A / 25A	30A / 32A W/T
380 - 520 VDC	44A	60A DC/63A DC W/T

It is recommended, for simplicity and ease of upgrades, that the circuit breaker ratings in this table be used on all power cords for all installations. The actual power drawn (heat load) by any configuration will not be affected.

Note: Small currents can appear on the server earth ground connection under normal server operation.

1. Occasionally an input phase voltage is lost. The server will continue to operate normally, but leakage current (tens of mAs) will appear on the ground until the missing phase voltage is restored.
2. Background currents due to small voltage gradients in the facility's ground grid can appear on the server earth connection because this connection is redundant.
3. The system's utility power supply circuitry will not affect the accuracy of industry standard insulation monitoring equipment in the data center.

For most reliable operation, circuit breakers that react to currents detected on ground (e.g. Earth Leakage Circuit Breakers or Residual Current Circuit Breakers) are not recommended for use with IBM Z servers. By internal design and grounding, IBM Z servers are fully certified for safe operation without them (meets IEC, EN, UL, CSA 60950-1 standards).

However, if leakage detection circuit breakers are required by local electrical practice, they can be used down to 100 mA. To safeguard against spurious tripping:

1. The Data Center ground grid should be constructed in accordance with best practices to avoid significant voltage gradients.
2. The facility power infrastructure should be as reliable as possible.
3. The utility connections from the breaker panel to the two or four power cord inputs should be reasonably equal in length or at least no one connection should be much shorter than the others.

If spurious tripping is experienced, corrections must be made in one or more of the above areas.

Internal battery feature (FC 3216)

The Internal Battery Feature (IBF) (FC 3216) is optional on the 3906. In the event of input power interruption to the system, the internal battery feature will provide sustained system operation for the times listed in the following table.

Table 47. IBF holdup times

	Number of PCIe I/O drawers					
	0	**1**	**2**	**3**	**4**	**5**
1 processor drawer M01 or LM1	20.0 min	13.4 min	9.9 min	8.7 min	N/A	N/A
2 processor drawers M02 or LM2	8.9 min	12.5 min	10.3 min	8.9 min	7.8 min	7.0 min
3 processor drawers M03 or LM3	9.6 min	8.2 min	7.3 min	6.6 min	6.1 min	4.9 min
4 processor drawers M04 or LM4	6.7 min	6.1 min	4.9 min	4.5 min	4.0 min	3.7 min
4 processor drawers M05 or LM5	6.1 min	4.9 min	4.5 min	4.0 min	3.7 min	3.3 min

Note:

1. The holdup times in this table are valid for batteries 3 years old or less that have seen normal service life (2 or less complete discharges per year) with the system input power at N+1 operation.
2. Batteries are only added up to the number of Bulk Power Regulators associated with the power cords for BPR1, BPR2, and BPR3 in the BPA.
3. These holdup times are estimates. Your particular battery holdup time for any given circumstance may be different.
4. Holdup times vary depending on the number of BPRs installed. As the number of BPRs increases, the holdup time also increases until the maximum number of BPRs is reached. Once six BPRs (three per side) are installed no additional batteries are added so the time decreases from that point.

Unit emergency power off (UEPO)

There is a unit emergency power off (UEPO) switch on the front of the primary frame (A frame) of each system. When tripped, the UEPO switch will immediately disconnect utility and battery power from the machine functional unit. Utility power is confined to the machine power compartment. All volatile data will be lost.

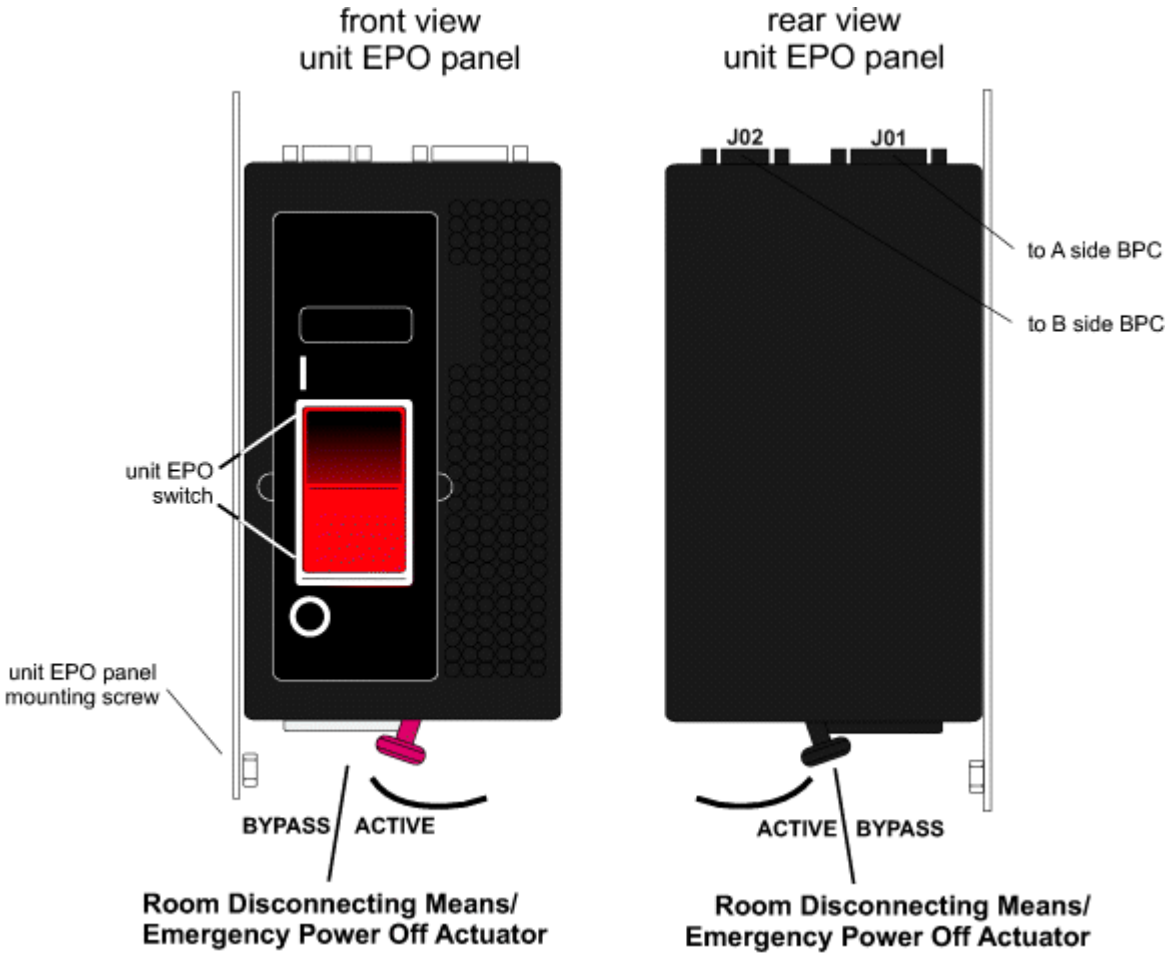


Figure 23. UEPO panels

Figure 23 on page 113 illustrates both the front and the rear of the machine UEPO panel. The rear view shows where the room electrical power disconnecting means, or room Emergency Power Off, EPO, cable plugs into the machine. Notice the switch actuator. Once moved to make the cable connection possible, the room disconnecting means / EPO cable must be installed for the machine to power on.

Computer room emergency power off (EPO)

When the internal battery backup feature is installed and the room disconnecting means / EPO is tripped, the batteries will engage and the computer will continue to run. It is possible to attach the computer room disconnecting means / EPO system to the machine UEPO switch. When this is done, tripping the room disconnecting means / EPO will disconnect all power from the line cords and the internal battery backup unit. In this event all volatile data will be lost.

To incorporate the IBF into the room disconnecting means / Emergency Power Off (EPO) systems, a cable must be made to connect to the back of the system UEPO panel. The following diagram illustrates how this connection is made.

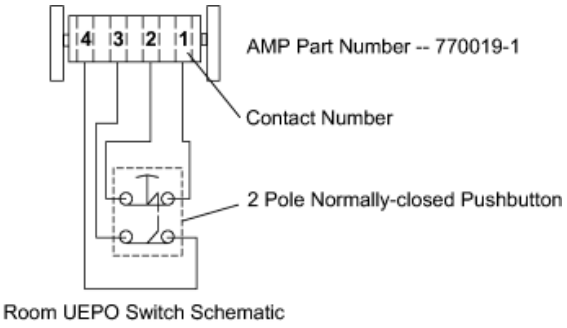


Figure 24. UEPO switch schematic

In Figure 24 on page 114, an AMP connector 770019-1 is needed to connect to the system UEPO panel. For room disconnecting means / EPO cables using wire sizes #20 AWG to #24 AWG use AMP pins part number 770010-4. The permissible resistance of the customer connection is 5 Ohms Maximum (~200' of #24 AWG).

Power plugs and receptacles

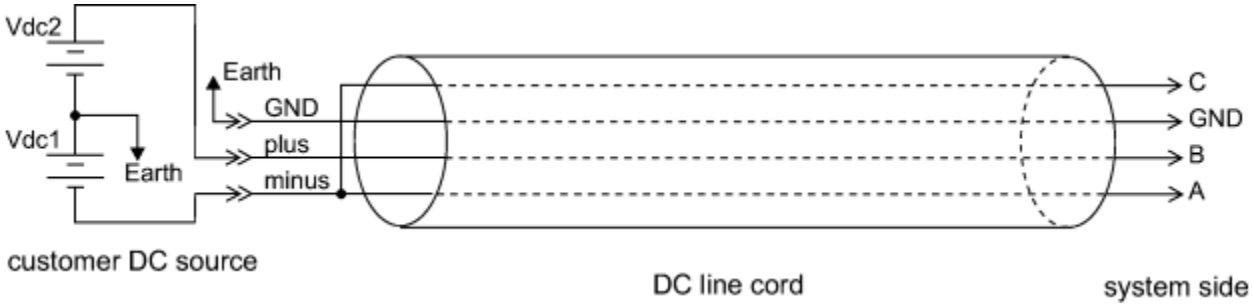
Plugs are shipped with the machine line cords in USA and Canada. The line cord length is 4267.2 mm (14 ft). Power plugs in the following table are approved for use with specified models and meet the relevant test laboratory or country/test-house standards. The power plug must be connected to a correctly wired and grounded receptacle. The customer is responsible for receptacle wiring.

For countries that require other types of plugs or receptacles, the system is shipped without plugs on the line cords, and you are responsible for supplying and installing both plugs and receptacles.

Important:
In a typical three-phase power cord, there are **five** wires inside the cut cord cable. There are the three phase wires, one ground wire and there is a fifth, small diameter wire, connected to the cable shield, that acts as a drain. This drain wire must be connected to the **cable ground, NOT neutral**.

DC power cords

The DC power cord is illustrated below.



The DC feed is on the **B** line. The **C** and **A** lines are the DC return. The crimp between the **C** line and **A** line is internal on cords with a customer plug. For cut end cords, the **C** and **A** lines must both be tied to the negative side of the source because all four wires exit the cord body separately. Reference the following table for DC voltage information.

Table 48. Input voltage range

Parameter	Absolute maximum	Absolute minimum
Vdc1 + Vdc2	550V	330V
Vdc1	550V	0V
Vdc2	420V	0V

A DC line cord locking ring must be attached on both ends of all DC line cords to ensure the DC line cords are de-energized before unplugging,

Note: The DC line cord locking ring will have the following label attached.

DANGER: Arc Flash/Arc Blast hazard when disconnected with power on. Turn off power before disconnecting. (L015)

Supported power cords

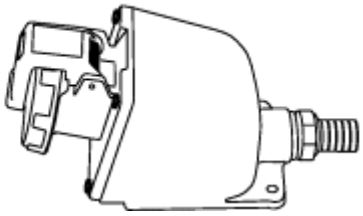
Table 49. Supported power cords

System location	Supported power cord feature codes [3]	 Watertight plug	 Watertight receptacle	 Watertight connector
USA, Canada, Japan (200-240 VAC) connector body - Blue	8952 [5] 8955 [5] 8993	60A IEC-309 (provided as part of the cord)	60A IEC-309 460R9W (not provided)	60A IEC-309 460C9W (not provided)
USA (480 VAC) connector body - Red	8950 8983	30A IEC-309 (provided as part of the cord)	30A IEC-309 430R7W (not provided)	30A IEC-309 430C7W (not provided)
USA (380-415 VAC) connector body - Red	8976 8977	30A IEC-309 [4] provided as part of the cord)	30A HBL430R6V02 (not provided)	30A HBL430C6V02 (not provided)
USA, Canada, Japan (380-520 VDC) connector body - Black	8947 8953 8963	60A (provided as part of the cord)	60A HBL360R8WDC (not provided)	60A HBL360C8WDC (not provided)
World Trade (208-240 VAC)	8949 8982 8996	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)	(not specified)
World Trade (380-415 VAC)	8951 8988 8998	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)	(not specified)
World Trade (380-520 VDC)	8948 8965	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)	(not specified)

Notes:

1. It is strongly recommend that you use of a metal backbox (example shown below) with our line cords using IEC-309 plugs. Although in-line connectors and nonmetallic backboxes are available and compatible, they are not recommended. These recommendations are based on the metal backbox providing:
   - An added level of protection against a miswired phase and ground reversal
   - In some cases, a metal backbox may be better for EMI mitigation

   You may choose not to use a metal backbox. In this case, please check your local code for specific requirements.
2. The customer must obtain the appropriate plugs and receptacles, based on existing electrical codes, where those plugs and receptacles are not provided with the system.
3. See “Line cord wire specifications” on page 121 for descriptions of the power cord feature codes.
4. This plug is dual listed at 30A and 32A.
5. Only the connector is supported because these cords attach directly to the system.

Grounding specifications

Every three-phase circuit must contain three-phase conductors and an insulated equipment-grounding conductor. Every single-phase 120 volt branch circuit (used for the Hardware Management Console and service outlets) must contain one phase conductor, a neutral conductor, and an insulated equipment-grounding conductor.

For 208 VAC through 240 VAC installations worldwide, the equipment-grounding conductor must match local electrical codes and must be green with or without one or more yellow stripes on the insulation. It is recommended that the ground wire be the same size as the phase conductor wires.

Conduit must not be used as the only grounding means. However, any conduit or cable shield must be connected at both ends in such a way that it is included in the grounding path in parallel with the grounding conductor it contains. Most electrical codes require that branch circuit wiring be located in metallic conduit, or be made from shielded cable, if located under a raised floor. Even when not required by local regulations, some form of shield around the branch circuit wiring is strongly recommended as a means of reducing coupling of high-frequency electrical noise into signal and control cables.

For information about additional recommendations and requirements for equipment grounding, go to Resource Link (http://www.ibm.com/servers/resourcelink). See **General Information for Planning a Physical Site**.

Top exit power cords

The 3906 has the option of top exit power cord cabling. There are several power cord options specifically made for top exit, and you must chose one of these if you want to have the power cords exit through the top of the server. The top exit power cords are manufactured with additional hardware that mounts the cord to the frame of the machine and provides an EMC seal at the same time.

For power cord top exit, choose from the following power cord feature codes: 8947, 8948, 8949, 8950, 8951, 8952, 8953, 8955, and 8977.

For feature codes 8947, 8952, 8953, and 8955, these 60 amp IBM cords end directly at the top of the frame. Therefore, your cords must be long enough to reach the frame. See Figure 25 on page 119.

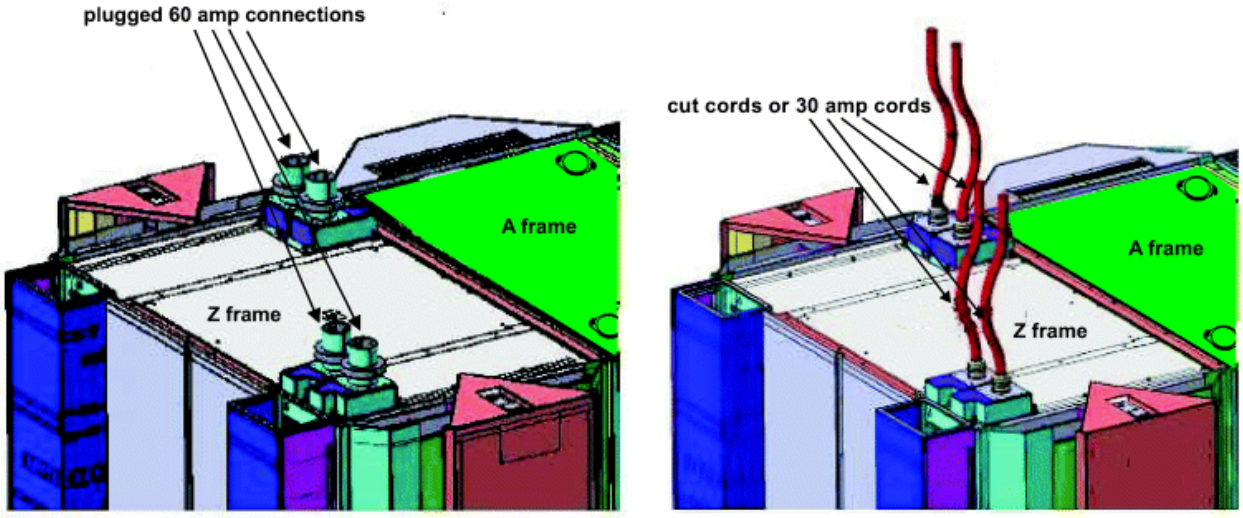


Figure 25. Top exit power cords - plugged 60 amps connection, cut cord or 30 amp cord connection

For feature codes 8948, 8949, 8950, 8951, and 8977, your receptacle must drop to within 305 mm (1 ft) of the top of the frame and be no further than 305 mm (1 ft) from the front cover or side cover of the frame. (See Figure 26 on page 120 and Figure 25 on page 119.

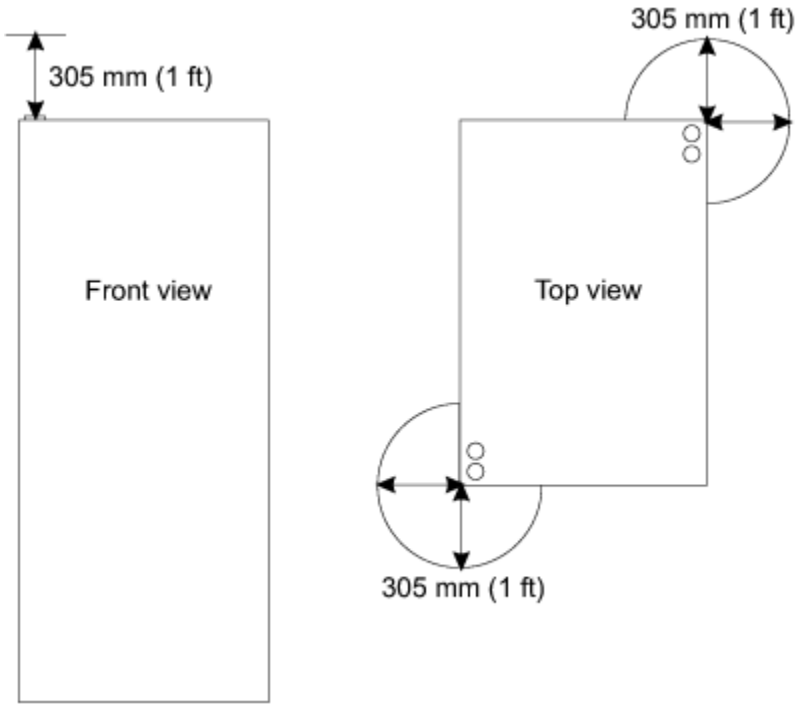


Figure 26. Receptacles for top exit power cords

Line cord wire specifications

Line cord usage location	Feature code	AWG # / type	Number of shields	Connector supplied	Bulk outside diameter mm (in)
USA, Canada, Japan (380-520 VDC) 60A plugged top exit cord ends at top of rack	8947	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
World Trade (380-520 VDC) cut top exit cord 14 ft	8948	#6 AWG Type PPE	1 (overall gross shield)	No	28.5 (1.12)
World Trade, low voltage cut top exit cord 14 ft	8949	#6 AWG Type PPE	1 (overall gross shield)	No	28.5 (1.12)
USA (480 VAC) 30A plugged top exit cord 6 ft ends at top of rack	8950	#10 AWG Type ST	1 (overall gross shield)	Yes	18.54 (0.73)
World Trade, high voltage cut top exit cord 14 ft	8951	#10 AWG Type ST	1 (overall gross shield)	No	18.54 (0.73)
USA, Canada, Japan (200 VAC) 60A plugged top exit cord ends at top of rack	8952	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
USA, Canada, Japan (380-520 VDC) 60A plugged top exit cord ends at top of rack	8953	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
USA, Canada, Japan (200 VAC) 60A plugged top exit cord ends at top of rack	8955	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
USA, Canada, Japan (380-520 VDC) 60A bottom exit cord 14 ft	8963	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
World Trade (380-520 VDC) bottom exit cord 14 ft	8965	#6 AWG Type PPE	1 (overall gross shield)	No	28.5 (1.12)
USA (380-415 VAC) 30A bottom exit cord 14 ft	8976	#10 AWG Type ST	1 (overall gross shield)	Yes	18.54 (0.73)

Line cord usage location	Feature code	AWG # / type	Number of shields	Connector supplied	Bulk outside diameter mm (in)
USA (380-415 VAC) 30A plugged top exit cord 6 ft ends at the top of rack	8977	#10 AWG Type ST	1 (overall gross shield)	Yes	18.54 (0.73)
World Trade, low voltage (200-240 VAC) bottom exit cord 14 ft	8982	#6 AWG Type DP-1	1 (overall gross shield)	No	28.5 (1.12)
USA (480 VAC) 30A bottom exit cord 14 ft	8983	#10 AWG Type DP-1	1 (overall gross shield)	Yes	14.48 (0.57)
World Trade, high voltage (380-415 VAC) bottom exit cord 14 ft	8988	#10 AWG Type DP-1	1 (overall gross shield)	No	14.48 (0.57)
USA, Canada, Japan (200-240 VAC) 60A bottom exit cord 14 ft	8993	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
World Trade, low voltage (200-240 VAC) bottom exit cord 14 ft low smoke, halogen-free	8996	#6 AWG Type LSZH	1 (overall gross shield)	No	25.91 (1.02)
World Trade, high voltage (380-415 VAC) bottom exit cord 14 ft low smoke, halogen-free	8998	#10 AWG Type LSZH	1 (overall gross shield)	No	15.00 (0.59)

Line cord usage location	Feature code	AWG # / type	Number of shields	Connector supplied	Bulk outside diameter mm (in)

Note:

1. Where plugs are provided, Hubbell is the plug supplier.
2. If you choose to use a Hubbell receptacle, do NOT use the Hubbell C-Series Light Industrial
3. The customer must obtain the appropriate plugs and receptacles, based on existing electrical codes, where those plugs and receptacles are not provided with the system.
4. The power cord set(s) provided are for use only with this product.
5. FCs 8952 and 8955 are for top exit connections to a 200 to 240 VAC source in the US, Canada and Japan. They have IEC-309 60A AC plugs hard connected to the top of the frame. They are coordinated as follows:
   - For systems requiring 2 cords, order FC 8952.
   - For systems requiring 4 cords (or plan ahead to 4 cords), order both 8952 and 8955.
   - For an upgrade from a system with 2 cords to a system requiring 4 cords, order 8955.
6. FCs 8947 and 8953 are for top exit connections to a 380 to 520 VDC source in the US, Canada and Japan. They have IEC-309 60A DC plugs hard connected to the top of the rack. They are coordinated as follows:
   - For systems requiring 2 cords, order FC 8947.
   - For systems requiring 4 cords (or plan ahead to 4 cords), order both 8947 and 8953.
   - For an upgrade from a system with 2 cords to a system requiring 4 cords, order 8953.

Wire colors for cut-end three-phase alternating current cords

Wire Number	Color	Description
Line 1	Brown	Phase 1 (labeled "PH-1" on the wire insulation
Line 2	Black	Phase 2 (labeled "PH-2" on the wire insulation
Line 3	Gray	Phase 3 (labeled "PH-3" on the wire insulation
Ground	Green/Yellow	Ground (labeled "GND" on the wire insulation
Drain	clear or uninsulated	Cable shield - must be connected to GROUND

Wire colors for cut-end direct current cords

Wire Number	Color	Description
Line 1	Black	(labeled "**-**" on the wire insulation
Line 2	Red	(labeled "**+**" on the wire insulation
Line 3	Black	(labeled "**-**" on the wire insulation
Ground	Green/Yellow	Ground (labeled "GND" on the wire insulation
Drain	clear or uninsulated	Cable shield - must be connected to GROUND

Line physical protection

In US installations, the line cord must meet National Electric Code (NEC) requirements. When line cords are run on the surface of the floor, they must be protected against physical damage. (See NEC 645-5.) For other countries, local codes apply.

Chapter 6. Hardware Management Console and Support Element communications

Support Element

The 3906 is supplied with dual 1U 2461 Support Elements (2461-SE2); both with a keyboard and display. One is always active while the other is strictly an alternate.

Power for the Support Element servers is supplied by the 3906 power supply, so there are no additional power requirements.

The Support Elements on the 3906 connects to the LAN via the customer network switch. Then the Support Elements connect to the system control hubs. The Hardware Management Console also connects to the LAN via the customer network switch.

Hardware Management Console

A Hardware Management Console (FC 0092, FC 0094, FC 0095, FC 0096, FC 0082, and FC 0083) is required to operate the 3906. FC 0082 and FC 0083 are optional features on new orders. You can only carry forward FC 0092, FC 0094, FC 0095, and FC 0096. A single console can support multiple servers and can be located remotely to the physical sites.

If you plan to use the ensemble capabilities of the 3906, you will need to order FC 0025, Unified Resource Manager and provide two HMCs - one to serve as the primary HMC for the ensemble, and one to serve as the alternate HMC.

Note: In addition to performing ensemble-related tasks for any CPC in the ensemble, the primary HMC can perform all nonensemble tasks on a CPC, whether it is a member of an ensemble or not a member of an ensemble.

The machine type and model number of the primary HMC and alternate HMC must be identical. Both must be either FC 0092, FC 0094, FC 0095, FC 0096, FC 0082, or FC 0083. Compare the machine type from the serial number label to ensure that both machines have the same machine type.

- The Hardware Management Console (FC 0092) consists of:
  - A processor or system unit, including two Ethernet LAN adapters, capable of operating at 10, 100, or 1000 Mbps and will use removable UFDs to install Licensed Machine Code (LMC)
  - A flat panel display
  - A keyboard and
  - A mouse
  - The console requires a customer-supplied table to hold the following:
    - The keyboard and mouse
    - A flat panel display (FC 6096)

  See Appendix B, “Hardware Management Console physical specifications,” on page 171 for physical specifications of HMC (FC 0092) and the flat panel display (FC 6096).
- The Hardware Management Console (FC 0095 or FC 0082) consists of:
  - A processor or system unit, including two Ethernet LAN adapters, capable of operating at 10, 100, or 1000 Mbps and will use removable UFDs to install Licensed Machine Code (LMC)
  - Optional keyboard (FC 0153)
  - Optional mouse (FC 0152)
  - Optional display (FC 6096)

  - The console requires a customer-supplied table to hold the keyboard, mouse, and display.

  See Appendix B, “Hardware Management Console physical specifications,” on page 171 for physical specifications of the HMC (FC 0095 or FC 0082) and the flat panel display (FC 6096).

- The Hardware Management Console (FC 0094, FC 0096, and FC 0083) consists of:
  - 1U HMC system unit, including two Ethernet LAN adapters, capable of operating at 10, 100, or 1000 Mbps and will use removable UFDs to install Licensed Machine Code (LMC)
  - 1U console unit that holds the flat panel display and the keyboard
  - Three C13/C14 10 amp power jumper cables (2.8 m (9 ft))
  - The customer must provide the following:
    - A rack to hold the 1U Hardware Management Console and the 1U console unit
    - Three power receptacles, which provides C13 outlets for the C13/C14 power jumper cables -- two for the 1U HMC system unit and one for the display/keyboard unit.

  The 1U HMC system unit and the 1U keyboard/display unit must be mounted in two adjacent 1U locations in the ergonomic zone in the rack. The following are recommendations for placement of the 1723-8BX keyboard/display unit into the customer supplied rack:

  - If you are standing when using the 1723-8BX keyboard/display unit, place the unit in EIU locations 21, 22, or 23.
  - If you are sitting when using the 1723-8BX keyboard/display unit, place the unit in EIU locations 12, 13, or 14.
  - For special accommodations, you need to make adjustments in the placement of the 1723-8BX keyboard/display unit in the rack that meet your needs.

  See Appendix B, “Hardware Management Console physical specifications,” on page 171 for physical specifications of HMC (FC 0094), HMC (FC 0096), HMC (FC 0083) the flat panel display (FC 6096), and the 1723-8BX keyboard/display unit.

The Hardware Management Console (FC 0092, FC 0095, and FC 0082) requires two 110/120V outlets for USA and Canada. The Hardware Management Console (FC 0094, FC 0096, and FC 0083) uses three PDU plug positions (two for the 1U HMC unit, and one for the 1723-8BX display/keyboard unit) for USA and Canada. (Other power requirements are country dependent.)

An Ethernet switch will not be offered as a configurable feature on the 3906. If an Ethernet switch is needed to manage the Ethernet connection between the Support Elements and HMCs, you must supply your own. It is recommended that the Ethernet switch support a speed of 1 Gb. However, if you are upgrading to a 3906 and Ethernet switch, FC 0070, is found on the base machine, it will be carried forward.

The Ethernet switch requires a single 110/120V outlet for USA and Canada. (Other power requirements are country dependent.)

Physical specifications for the Hardware Management Console components are located in Appendix B, “Hardware Management Console physical specifications,” on page 171.

Ethernet LAN switch support

The following is general information relevant to many Ethernet switches. Refer to the manufacturer's User's Guide that came with your switch for installation instructions.

There **must** be an Ethernet switch/hub available to connect the Hardware Management Consoles to your LAN. The Ethernet switch/hub is a standalone unit located outside the frame and which operates on building AC power. An Ethernet switch will not be offered as a configurable feature on 3906. You must supply your own Ethernet switch unless you are upgrading to a 3906. If you are upgrading to a 3906 and Ethernet switch, FC 0070, is found on the base machine, it will be carried forward. It is recommended that the Ethernet switch support a speed of 1 Gb.

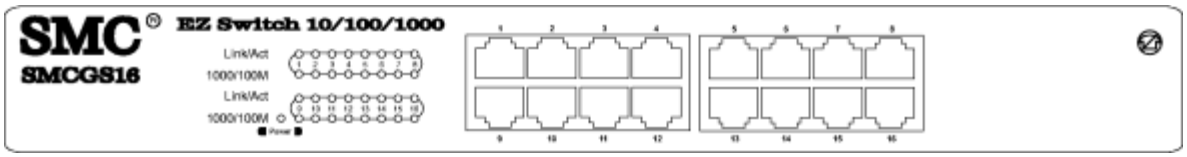
Typical Ethernet switch/hub characteristics:

- 16 auto-negotiation ports
- 10/100/1000 Mbps data rate
- Full or half duplex operation
- Auto-MDIX on all ports
- Port Status LEDs
- 100 to 240 VAC, 50 or 60 Hz power

Ethernet switches supporting auto-MDIX on all ports use a straight-through cable between any two ports.

To provide redundancy for the HMCs, two switches/hubs should be used.

Switch Example



Ethernet network connection requirements

MUST READ:

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller for any questions.

The preceding statement does NOT exclude using the network for private communications, such as connection to the Remote Support Facility.

On the 3906 , the install team must connect the Ethernet adapters for any HMC(s) into an Ethernet switch. This switch can then be connected to J03 and J04 on the Support Element servers. (See Figure 27 on page 128.)

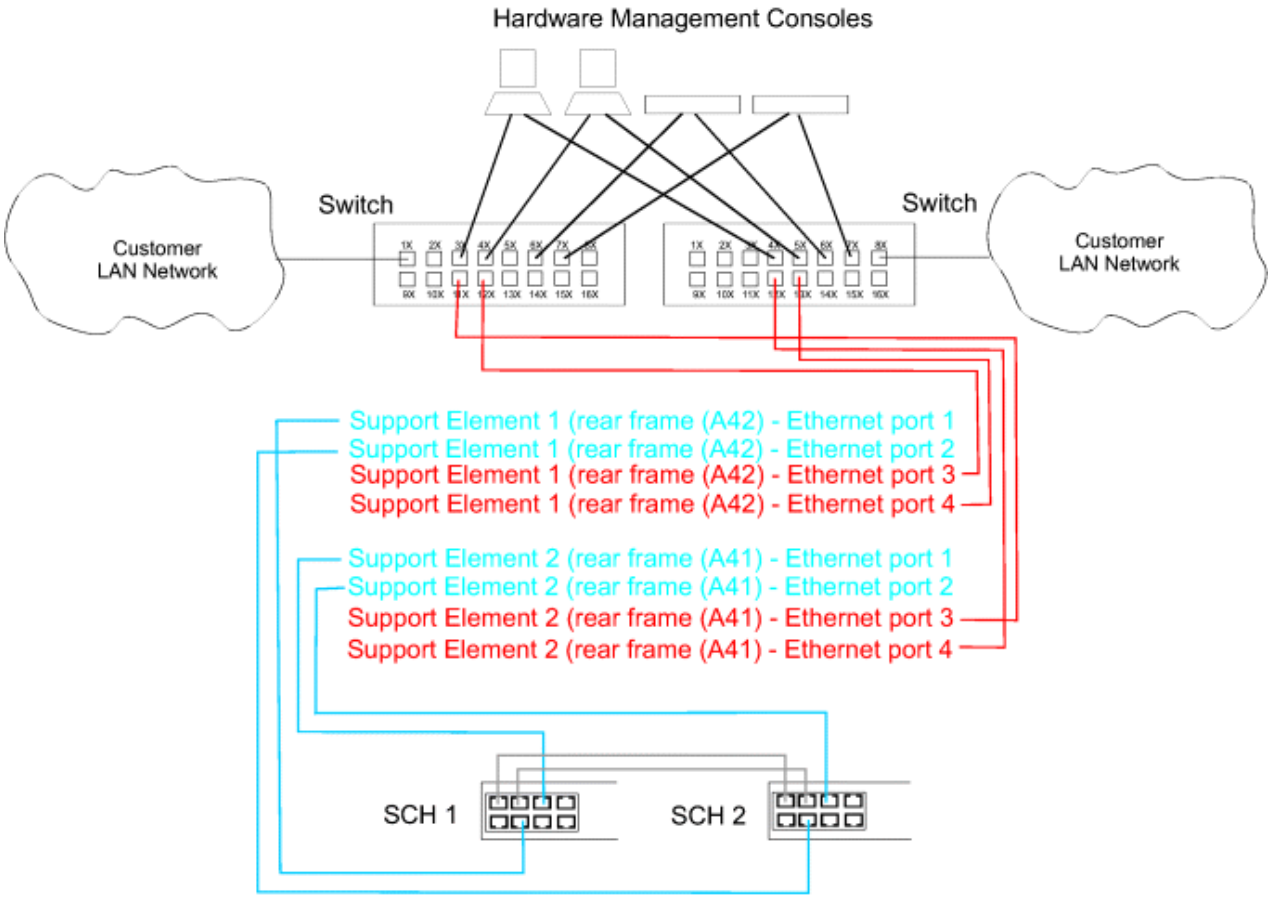


Figure 27. Two-switch configuration

Notes:

1. Connect customer LANs, via Ethernet switches, to Ethernet ports J03 and J04 on the Support Element servers. Customer **LAN 1 should be plugged into Ethernet port J03** on the Support Element servers. Customer **LAN 2 should be plugged into Ethernet J04** on the Support Element servers.
2. Never connect an HMC directly to Ethernet ports J03 and J04 on the Support Element servers.

Hardware Management Console and Support Element wiring options

A local Hardware Management Console must be connected to its Support Elements using Local Area Network (LAN) wiring. The Hardware Management Console and the Support Elements both come with Dual Ethernet LAN adapters.

The communication protocol (TCP/IP) used in Support Element to Hardware Management Console communication is defined for both adapters in the Support Elements.

Notes on wiring with multiple adapters:

1. The Hardware Management Console supports dual Ethernet paths to Support Elements. This allows automatic redundant network paths so that the failure of a single network has no affect on Hardware Management Console to Support Element communication.
2. When configuring multiple adapters the address must be defined in different subnets.

Because HMCs FC 0092, FC 0094, FC 0095, FC 0096, FC 0082, and FC 0083 only come with dual Ethernet features, no additional explanation of wiring scenarios is offered here.

Trusted Key Entry (TKE)

The 3906 may have a Crypto Express5S (FC 0890) or a Crypto Express6S (FC 0893) feature for applications where extensive data security is required. For these systems, there is a separate console available for authorized access to the Crypto Express5S (FC 0890) or the Crypto Express6S (FC 0893). This console is named the Trusted Key Entry (TKE) workstation.

TKE 9.1 (FC 0880) is required to manage a Crypto Express5S or a Crypto Express6S and the additional domains provided on the Crypto Express5S or the Crypto Express6S on a 3906.

The TKE workstations (FC 0849, TKE 2461-TW1 (FC 0081), and TKE 2461-TW2 (FC 0086)) include a system unit, flat panel display, mouse, keyboard, and line cord. The TKE workstations (TKE 2461-SE1 (FC 0080) and TKE 2461-SE2 (FC 0085)) include a system unit and a 1U console unit that holds the flat panel display and the keyboard. The built-in Ethernet adapter supports a link data rate of 10, 100, or 1000 Mbps. A UFD drive is available for installation of Licensed Machine Code on all TKE workstations.

FC 0842, FC 0847, FC 0097, and FC 0098 can only be carried forward; however, to use with the 3906, they must be converted by replacing the installed Crypto adapter card with a 4768 TKE Crypto adapter card (FC 0844).

- Mouse feature (FC 0152), keyboard feature (FC 0155), and monitor feature (FC 6096) are optional for use with TKE (FC 0081) and TKE (FC 0086).

  Keyboard/monitor/mouse feature (FC 0156) is optional for use with TKE (FC 0080) and TKE (FC 0085).

The TKE workstation attaches to the customer LAN, providing a security-rich, flexible method of providing master key and operational key entry to locally and remotely managed Cryptographic Coprocessor features.

TKE with optional Smart Card Reader, FC 0885 or FC 0891, allows access to and use of confidential data on the Smart Card, protected by a user defined personal identification number (PIN) code providing secure storage, access, transport and entry of master and operational key parts into the TKE workstation. The following characteristics pertain to the Smart Card Reader:

- The Smart Card Reader is an optional security device that attaches to the TKE.
- TKE logon profiles can be placed on smart cards, which provide enhanced control over the sign on processes.
- FC 0885 and FC 0891, contains two Smart Card Readers, two serial port "Y" adapters, two serial cables, and 20 blank Smart Cards. The cables provide both power source for the SCR and the communication path between the SCR and the TKE workstation.
- A TKE workstation and the TKE 7.2 or later level code are corequisites for ordering the Smart Card reader.
- FC 0884, FC 0892, and FC 0900 provide the ability to order additional blank Smart Cards. The Smart Card Reader is a corequisite for ordering additional Smart Cards.
- If you currently have the Smart Card Reader feature (FC 0885) and Additional Smart Card feature (FC 0884), they can only be carried forward to TKE 9.1 as follows:
  - The smart card readers can be used on TKE 9.1 without any restrictions.
  - If you have initialized any smart cards as CA, TKE, EP11, or MCA smart cards, you can use them on your TKE 9.1 system without any restrictions.
  - If you have initialized any smart cards as IA or KPH smart cards, you can use them on your TKE 9.1 for migration tasks done with Crypto Express4S or below modules.
  - If you have initialized any smart cards as IA or KPH smart cards, you cannot use them for migration tasks done with Crypto Express5S or Crypto Express6S modules.

    Note: If data will eventually be applied to a Crypto Express5S, the collect and apply migration tasks must be performed from a TKE 9.1 using IA and KPH smart cards that were initialized on TKE 9.1.
  - A smart card from FC 0885 or 0884 can be initialized as any one of the 6 types (CA, TKE, EP11, MCA, IA or KPH) of smart cards on TKE 9.1.

To use the TKE function on a 3906, the Crypto Express5S (FC 0890) or Cyrpto Express6S (FC 0893) feature, TKE 9.1 (FC 0880), and CP Assist for Cryptographic Function (FC 3863) must be installed.

The TKE workstation requires two 110/120 volt outlets in the U.S. and Canada. Power requirements vary in other countries.

LAN connections

LAN cabling is a customer responsibility. To connect the TKE workstation with Ethernet to a LAN, a Category 5 Unshielded Twisted Pair (UTP) cable terminated with an RJ-45 connector is required.

Planning for an ensemble

If you are planing to use a z14 in an ensemble, you must order FC 0025, which supplies the ensemble management code, and you must supply two HMCs (FC 0092, FC 0094, FC 0095, FC 0096, FC 0082, or FC 0083), which manage the ensemble. One of these HMCs is configured as the primary HMC for the ensemble, one as the alternate HMC.

Note: It is important to note that these two HMCs, if ordered, must be installed on the same Ethernet subnet, to insure redundancy.

If FC 0025, Unified Resource Manager, is to be used on a single 3906 and if LPAR to LPAR communications is required in a Unified Resource Manager defined VLAN, you must supply an LC Duplex directly-connected cables (not wrap cables, as was previously recommended). Those LC Duplex directly-connected cables plug into the two OSA-Express5S 10 GbE features or two OSA-Express6S 10 GbE features (CHPID type OSX).

Note:

1. When a z14 and FC 0025 (Unified Resource Manager) are ordered, eConfig does not force you to order two OSA-Express5S 10 GbE features or two OSA-Express6S 10 GbE features. However, those OSA features (OSA-Express5S 10 GbE Long Reach (FC 0415), OSA-Express5S 10 GbE Short Reach (FC 0416), OSA-Express6S 10 GbE Long Reach (FC 0424), OSA-Express6S 10 GbE Short Reach (FC 0425)) are required if you plan to use them for LPAR to LPAR communication.
2. The IODF must be shared among participating z/OS® LPARs.

Ensemble network configurations for a 3906 are as follows:

- z14 can be in an ensemble with one or more z14/z13/z13s/zEC12/zBC12 machines, zBX Model 004 machines, or zBX Model 003 machines (attached to zEC12 or zBC12).
- Customer-managed management network (with or without zBX)
  - A pair of HMCs (FC 0092, FC 0094, 0095, FC 0096, FC 0082, or FC 0083) with Unified Resource Manager (FC 0025) to control and manage the ensemble. One HMC is configured as the primary, the other as the alternate if the primary HMC fails.
  - Only one pair of HMCs running Unified Resource Manager per ensemble.
- Intranode management (INMN) network (**OSM** CHPID)
  - Two ports from two different OSA-Express4S 1000BASE-T Ethernet adapters (FC 0408), OSA-Express5S 1000BASE-T Ethernet adapters (FC 0417), or OSA-Express6S 1000BASE-T Ethernet adapters (FC 0426) (for redundancy) to provide management capability for a single node through the Unified Resource Manager.
- Intraensemble data (IEDN) network (**OSX** CHPID with a zBX in the ensemble or single node without a zBX for LPAR to LPAR communications)

  A z14 ensemble that has multiple nodes and no zBX cannot utilize the IEDN.
  - zBX in the ensemble, each node can have a connected pair of OSA-Express5S 10 GbE adapters or OSA-Express6S 10 GbE adapters (for redundancy).
  - Single node (with no zBX) will have a pair of 10 Gb loop back cables (customer-supplied) to allow the applications to share data on the IEDN between operating system images.

- Customer network connections (**OSD** CHPID)
  - For existing network connectivity from IBM Z applications to networks other than the IEDN.

Planning to load images to a system from a network (electronic code load)

If you are unable to use a USB flash memory drive or FC 0845 has been ordered or is present on the system, then you can use the **Manage Console Recovery** task to reload a selected system with a selected Driver 41 code image over the network (electronically). These instructions require actions on this Hardware Management Console (HMC) and the selected target system.

The target system can be any hardware that supports Driver 41.

During the installation of all systems with **FC 0845** the network setup to support electronic code load needs to be complete. For machines that do not want to use media or do not have access to Remote Support Facility (RSF), the installation is not complete until an FTP server is configured.

The following requirements and planning must be considered before using the capability to network load a target system.

- There must be two HMCs at Version 2.15.0 on every unique network subnet where a Hardware Management Console, Support Element (SE), or Trusted Key Entry (TKE) workstation is connected.
- BEFORE installing a new 3906 system (that is, with SEs), the HMC must have the SE recovery code image available in the Recovery Image section of the **Manage Console Recovery** task. If it is not visible, the import capability of the **Manage Console Recovery** task can be used.
- All Hardware Management Console customer LAN interfaces on the HMC, running the **Manage Console Recovery** task, must be configured as static. (Do not use DHCP to obtain addresses.)
- The targeted console system must be reachable on a local (same) subnet from at least one of the HMCs customer LAN interfaces.
- The subnet to the target console system must not have a DHCP server on it.
- Multiple HMC servers are allowed on the same subnet serving different targets, but is not recommended.

Attention: If you plan to use the electronic code load capability for target HMC or TKE systems at Driver 36 or Driver 27, you **must** ensure that the correct associated MCL is installed on your system before proceeding with the following instructions. Refer to *IBM Z® Electronic Code Load target system MCL requirements* (https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/zElectronicCodeLoadMcl?OpenDocument) for the specific MCL that is required for your system.

Chapter 7. Remote Support Facility (RSF) installation planning

The Remote Support Facility (RSF) provides communication to a centralized support network for problem reporting and service, as well as providing a means for remote operation of the Hardware Management Console. Communication with Remote Support is provided using an Internet connection.

Transmission to the Remote Support Facility requires a Domain Name Server (DNS) to be available. It must be configured on the call-home server HMC Console or proxy server connecting to the internet.

Choosing a communications method for remote support

You must choose method for connecting your server to service support through the Remote Support Facility:

- A direct connection from the Hardware Management Console to the Internet. This method is fast, reliable and uses the external customer firewall to control the connection.
- An indirect connection from the Hardware Management Console to the Internet using a proxy server. This method has the advantages of the direct connection plus it allows your enterprise the added control of the proxy. Potential additional advantages include the possibilities of logging and audit facilities using the proxy server.

The benefits of either a direct or indirect connection to the Internet will facilitate more rapid problem resolution for your enterprise.

An Internet-based Remote Support Facility (RSF) connection is recommended unless your enterprise security policies prohibit HMC communication with the Internet. The following information is designed to provide your networking team with the information they need to enable the Hardware Management Console to connect securely to the Internet.

Security characteristics of Remote Support Facility communications include:

- RSF requests are always initiated from the HMC to IBM. No inbound connections are ever initiated from support system.
- All data is transferred using encrypted sockets.
- When the HMC initiates a connection to RSF, it validates the trusted host by its digital signature issued for the support system.
- Data sent consists solely of hardware problem information and configuration data. No application or customer data is transmitted.

Using the internet for remote support

The HMC can be enabled to connect directly to the Internet or to connect indirectly, through a proxy server that you provide. The decision to use either a direct or indirect Internet connection for Remote Support depends on the security and networking requirements of your enterprise.

Hardware Management Console Direct Internet Connection
If your Hardware Management Console can be connected to the Internet, and the external firewall can be set to allow established TCP packets to flow outbound to the IP addresses described in “Server address lists and host names” on page 134, you can use a direct connection between the HMC and the Internet. The use of Source Network Address Translation (SNAT) and masquerading rules to mask the HMC's source IP address are both acceptable.

Hardware Management Console Indirect Connection with Proxy Server
For the Hardware Management Console to communicate successfully, your proxy server must allow connections to port 443.

When using an indirect connection, you can choose whether the proxy is to be directed to connect to the support system using an IP address or using a host name. You can control the set of targets for that proxy using either a host name or IP address, depending upon the security policies of your installation. See “Server address lists and host names” on page 134 for the list of host names and IP addresses.

If your installation requires host name addressing, your proxy must be configured with a Domain Name Server.

Server address lists and host names

The internet-facing HMC or proxy requires outbound TCP/IP connections to be allowed to port 443 using the IP addresses that correspond the internet protocol used.

IPv4 addresses (LMC 2.12.1 and later)

Internet connectivity using IPv4 requires outbound connectivity to the following IP addresses:

- 129.42.54.189
- 129.42.56.189
- 129.42.60.189
- 129.42.26.224 (traditional - legacy support)
- 129.42.42.224 (traditional - legacy support)
- 129.42.50.224 (traditional - legacy support)

IPv6 addresses (LMC 2.12.1 and later)

Internet Protocol version 6 (IPv6) vastly extends the range of available IP addresses. Although IPv6 is not required for remote support facility connection, IBM now offers the capability to migrate to IPv6.

The customer requires that the alternate HMC and the primary HMC are not to be connected to the same switch, then the alternate HMC and the primary HMC must be defined on the same subnet and IPV6 multicast must flow both ways between the two HMCs.

Internet connectivity using IPv6 requires outbound connectivity to the following IP addresses:

- 2620:0:6c4:200:129:42:54:189
- 2620:0:6c0:200:129:42:56:189
- 2620:0:6c2:200:129:42:60:189
- 2620:0:6c0:1::1000 (traditional - legacy support)
- 2620:0:6c2:1::1000 (traditional - legacy support)
- 2620:0:6c4:1::1000 (traditional - legacy support)

Host names

If an SSL Proxy is used to access the Internet, you can configure the Hardware Management Console to send an HTTP Connect request to the proxy using either the IP addresses previously listed or using a host name. If you configure it to use a host name, your proxy must accept connections to port 443 on the following host names:

- esupport.ibm.com
- www-945.ibm.com (traditional - legacy support)

Chapter 8. I/O cabling and connectivity

Before you place your cable order, consider your future growth needs. You may wish to order cables longer than you need right now to avoid expansion problems in the future.

As processor packaging evolves, internal locations for various cable connections may shift, necessitating longer cables, even though the floor locations of connected devices have not changed.

This chapter includes:

- A description of the top exit I/O cabling option.
- A description of the IBM Site and Facilities Services.
- A list of customer fiber optic cabling responsibilities if the services are not elected.
- A description of the 3906 channel and coupling connections.
- A description of the Fiber Quick Connect fiber harness feature for FICON cables.

Top exit I/O cabling

The 3906 has an optional feature for top exit I/O cabling (FC 7942). These frame towers for I/O top exit will add the following approximate measurements:

Table 50. I/O top exit approximate measurements

Weight	Width	Height
70.8 kg (156 lbs) - (four top exit I/O cable towers)	305 mm (12 inches)	139.7 mm (5.5 in)

Note:

1. The height includes installed cable management brackets.

   The top of the top exit I/O cable towers are level with the top of the Z frame and A frame. Installing the cable management brackets adds 139.7 mm (5.5 in) to the overall height of the system. The overall height of the system, with the cable management brackets installed, is 2155.0 mm (84.8 in) from the floor. See Figure 28 on page 136 .

All I/O cables can be routed through the top exit I/O cable towers, including those designated for the Fiber Quick Connect feature.

Two top exit I/O cable towers are installed on the left side of the Z frame (one at the side front and one at the side rear). Two top exit I/O cable towers are installed on the right side of the A frame (one at the side front and one at the side rear). A shorter cover is located between the two towers on the left side of the Z frame and between the two towers on the right side of the A frame. See Figure 28 on page 136.

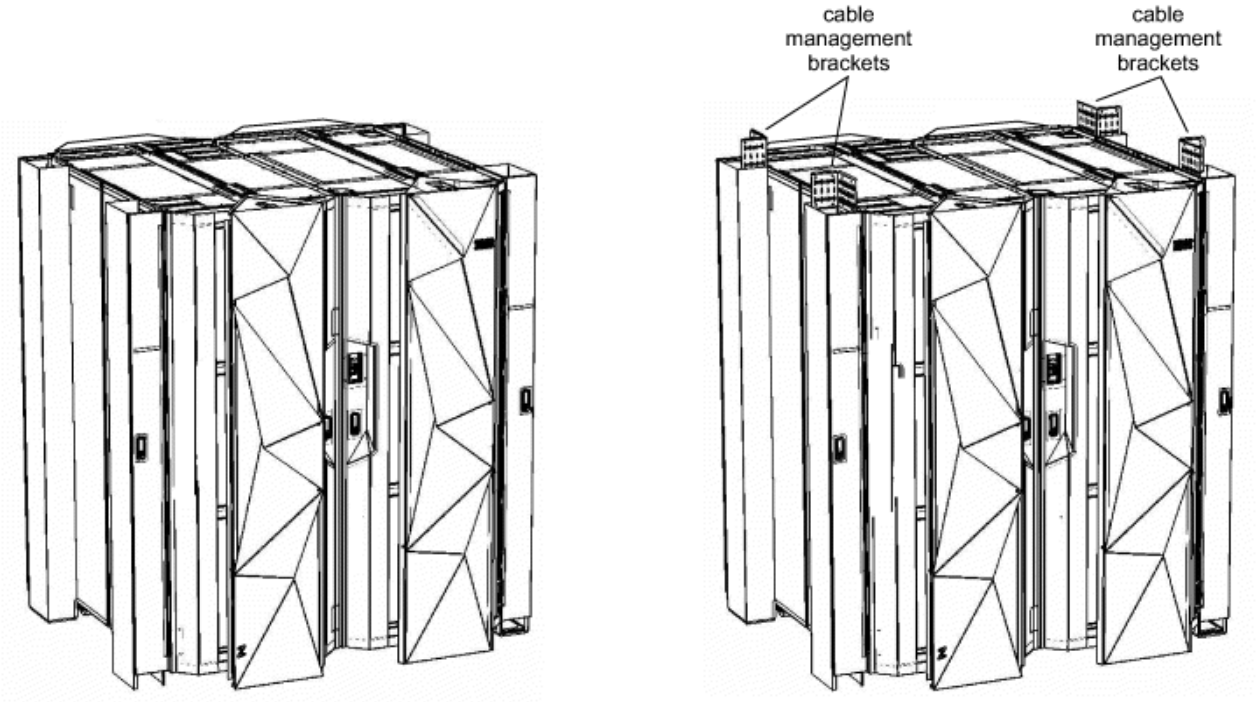


Figure 28. Top exit towers

IBM Site and Facilities Services

IBM Site and Facilities Services has a comprehensive set of scalable solutions to address IBM cabling requirements, from product-level to enterprise-level for small, medium, and large enterprises. These services fall into two major categories:

- IBM Facilities Cabling Services - fiber transport system
- IBM IT Facilities Assessment, Design, and Construction Services - optimized airflow assessment for cabling.

Planning and installation services for individual fiber optic cable connections are available. An assessment and planning for IBM Fiber Transport System (FTS) trunking components can also be performed.

These services are designed to be right-sized for your products or the end-to-end enterprise, and to take into consideration the requirements for all of the protocols and media types supported on z14, Emperor II, z13, Emperor, z13s, IBM LinuxONE Rockhopper™ (Rockhopper), zEC12, zBC12, z196, z114, System z10®, System z9®, and zSeries (for example, FICON, coupling links, OSA-Express) whether the focus is the data center, the Storage Area Network (SAN), the Local Area Network (LAN), or the end-to-end enterprise.

IBM Site and Facilities Services are designed to deliver convenient, packaged services to help reduce the complexity of planning, ordering, and installing fiber optic cables. The appropriate fiber cabling is selected based upon the product requirements and the installed fiber plant.

The services are packaged as follows:

- Under IBM Facilities Cabling Services there is the option to provide IBM Fiber Transport System (FTS) trunking commodities (fiber optic trunk cables, fiber harnesses, panel-mount boxes) for connecting to the z14, Emperor II, z13, Emperor, z13s, Rockhopper, zEC12, zBC12, z196, z114, z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890. IBM can reduce the cable clutter and cable bulk under the floor. An analysis of the channel configuration and any existing fiber optic cabling is performed to determine the required FTS trunking commodities. IBM can also help organize the entire enterprise. This option includes enterprise planning, new cables, fiber optic trunking commodities, installation, and documentation.
- Under IBM IT Facilities Assessment, Design, and Construction Services there is the Optimized Airflow Assessment for Cabling option to provide you with a comprehensive review of your existing data center cabling infrastructure. This service provides an expert analysis of the overall cabling design required to help improve data center airflow for optimized cooling, and to facilitate operational efficiency through simplified change management.

Refer to the **Services** section of Resource Link for further details.

Customer fiber optic cabling responsibilities

If you choose to plan and install your own I/O cabling, these are the specific tasks you must complete prior to system installation:

1. All cable planning and support
2. All purchasing of correct qualified cables
3. All installation of any required fiber optic or OSA-Express copper cables
4. All routing of cables to correct front/back floor cutouts for proper installation to the machine
5. If using the top exit I/O feature, you must install toroids on each copper Ethernet cable
6. All labeling of cables with PCHID numbers for proper installation to the machine.

Failure to accomplish these cabling tasks properly could lead to additional service charges during the machine installation in order to correct any problems incurred.

All jumper cables, cable components, and connector options are available through IBM Global Services. Contact your IBM installation planning representative, IBM product specialist, or IBM Connectivity Services specialist for details.

Note: Customer cabling preparation does not include plugging cables into the 3906 .

CAUTION: Servicing of this product or unit is to be performed by trained service personnel only. (C032)

FICON channel features

The FCP Express32S feature delivers up to 32 Gbps link data rate to servers, switches, control units and storage devices. The FICON Express16S+ and FICON Express16S features deliver up to 16 Gbps link data rate to servers, switches, control units and storage devices. The FICON Express8S features deliver up to 8 Gbps link data rate to servers, switches, control units and storage devices. FICON channels offer fast, efficient data transfer while allowing reuse of currently installed single mode and multimode fiber optic cables.

Configuration information

Table 51 on page 139 lists the FICON features. These features support two modes of operation:

- FC - native FICON, High Performance FICON for IBM Z (zHPF)
- FCP - Fibre Channel Protocol - attachment to SCSI disks in Linux on z Systems® and z/VM® environments.

Table 51. FICON feature codes

Feature code	Description	Fiber type
FC 0438 (PCIe) (2 ports)	FCP Express32S LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 km / 6.2 miles)
FC 0439 (PCIe) (2 ports)	FCP Express32S SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
FC 0427 (PCIe) (2 ports)	FICON Express16S+ 10KM LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 km / 6.2 miles)
FC 0428 (PCIe) (2 ports)	FICON Express16S+ SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
FC 0418 (PCIe) [1] (2 ports)	FICON Express16S 10KM LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 km / 6.2 miles)
FC 0419 (PCIe) [1] (2 ports)	FICON Express16S SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
FC 0409 (PCIe) [1] (2 ports)	FICON Express8S 10KM LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 km / 6.2 miles)
FC 0410 (PCIe) [1] (2 ports)	FICON Express8S SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))

Note:

1. This feature can only be carried forward.

- FCP Express32S LX and FCP Express32S SX are only available with IBM LinuxONE. If carried forward, function is limited to FCP only.
- FICON Express8S LX, and FICON Express8S SX can only be carried forward.
- All FICON Express feature codes use LC Duplex connectors.
- Each feature code represents a FICON base adapter with pluggable optic modules.
- Short wavelength and long wavelength optic modules cannot be mixed on the same FICON base adapter.
- Short wavelength and long wavelength features (FICON adapters) can coexist in the same PCIe I/O drawer.

See “FICON references” on page 140 for information about link distances and light loss budget.

The following graphics shows the FICON features, the ports on the feature, and the type of connector used.

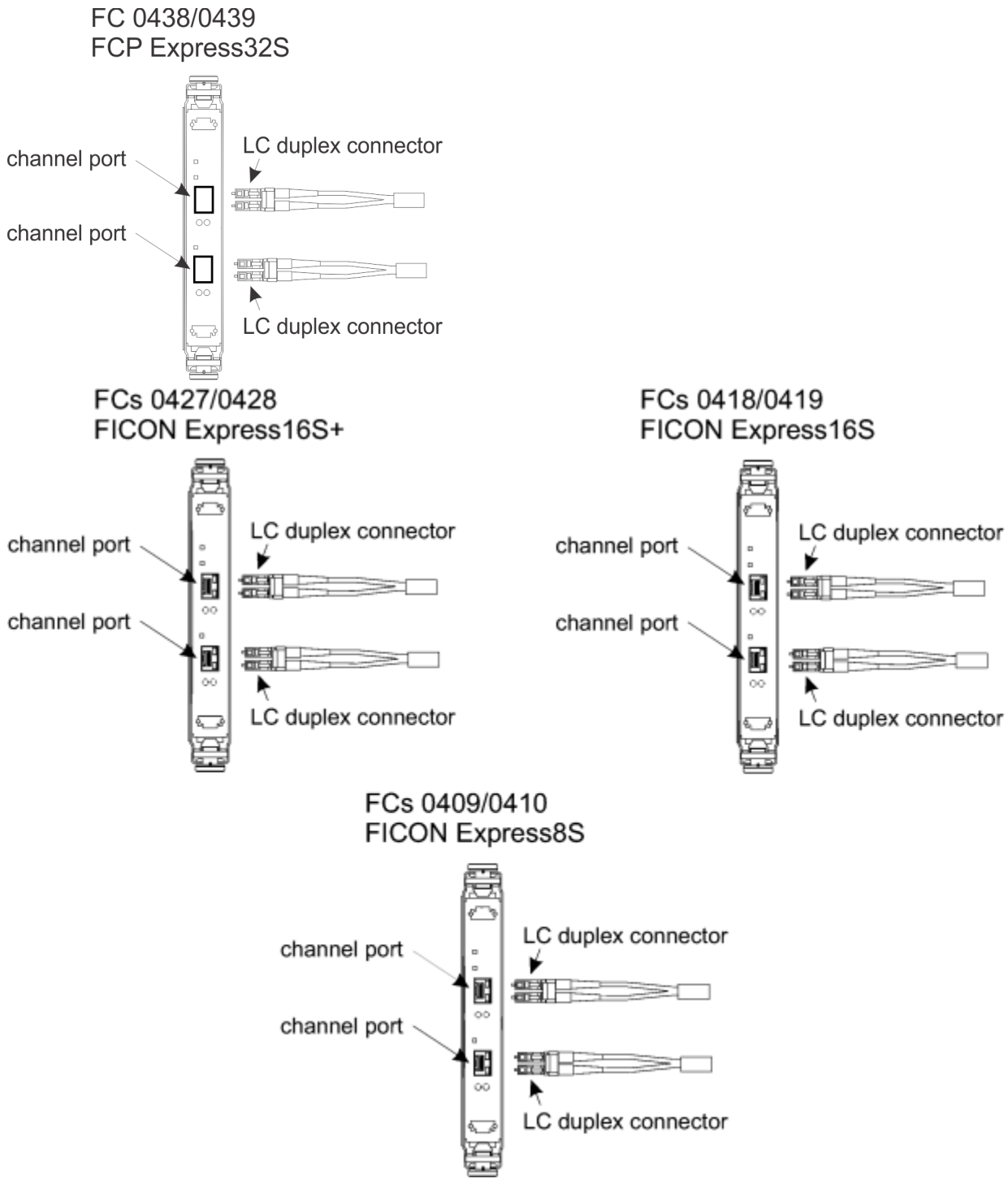


Figure 29. FICON Express features

FICON references

For additional information on planning for FICON channels see:

- *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*
- *FICON Channel-to-Channel Reference*

OSA-Express features

Open Systems Adapter-Express (OSA-Express) features enable connectivity to industry-standard local area networks (LANs).

Configuration information

Table 52 on page 141 lists the OSA-Express features:

Table 52. OSA-Express feature codes

Feature code	Feature description	Cable description	Connector type
FC 0429 (PCIe) (1 port)	OSA-Express7S 25 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0422 (PCIe) (2 port)	OSA-Express6S GbE LX	9 micron single mode	LC Duplex
FC 0423 (PCIe) (2 port)	OSA-Express6S GbE SX	50 and 62.5 micron multimode	LC Duplex
FC 0424 (PCIe) (1 port)	OSA-Express6S 10 GbE LR	9 micron single mode	LC Duplex
FC 0425 (PCIe) (1 port)	OSA-Express6S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0426 (PCIe) (2 port)	OSA-Express6S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0413 (PCIe) [1] (2 port)	OSA-Express5S GbE LX	9 micron single mode	LC Duplex
FC 0414 (PCIe) [1] (2 port)	OSA-Express5S GbE SX	50 and 62.5 micron multimode	LC Duplex
FC 0415 (PCIe) [1] (1 port)	OSA-Express5S 10 GbE LR	9 micron single mode	LC Duplex
FC 0416 (PCIe) [1] (1 port)	OSA-Express5S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0417 (PCIe) [1] (2 port)	OSA-Express5S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0408 (PCIe) [1] (2 ports)	OSA-Express4S 1000BASE-T	Category 5 or Category 6 UTP copper wire	RJ-45

Note:

1. This feature can only be carried forward.

Note: When configuring your IBM LinuxONE environment, if IBM Dynamic Partition Manager (DPM) is required, two OSA-Express 1000BASE-T adapters are needed for internal usage by DPM. Additional OSA or RoCE Express features must be ordered for system connectivity to data center networks.

The following graphics shows the OSA-Express features, the ports on the feature, and the type of connector used.

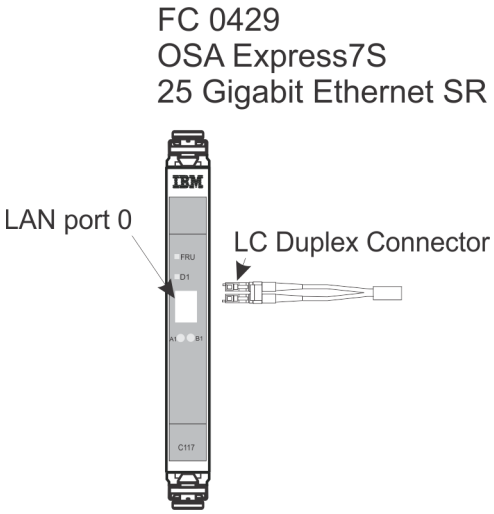


Figure 30. OSA-Express7S 25 GbE feature

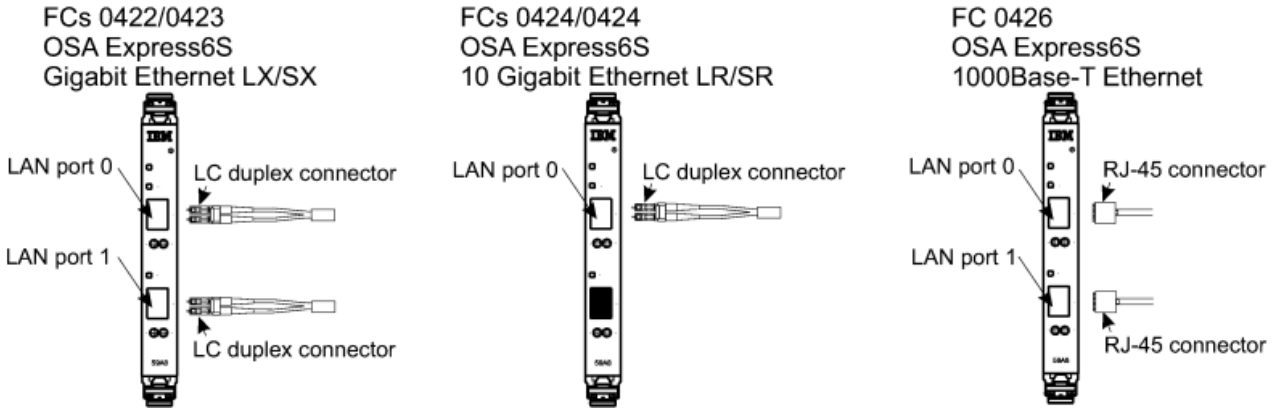


Figure 31. OSA-Express6S features

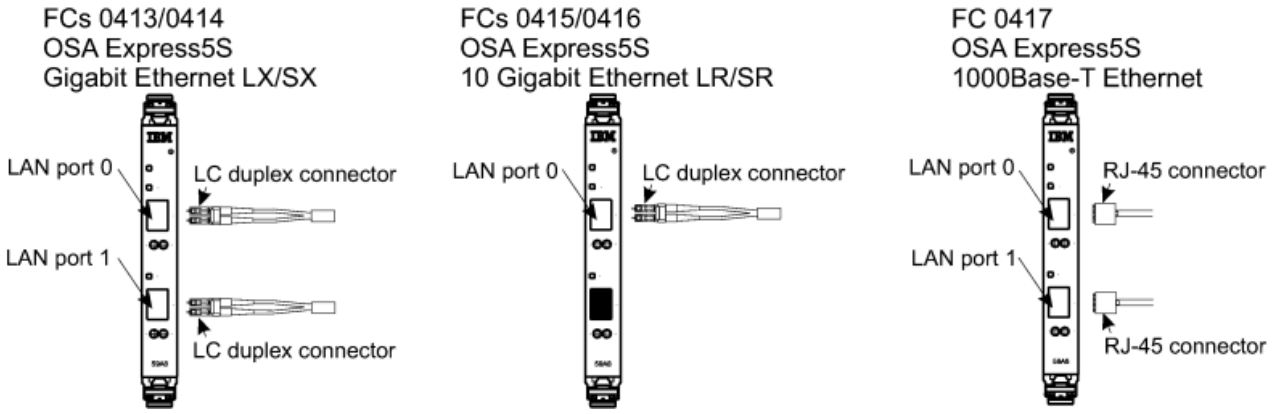


Figure 32. OSA-Express5S features

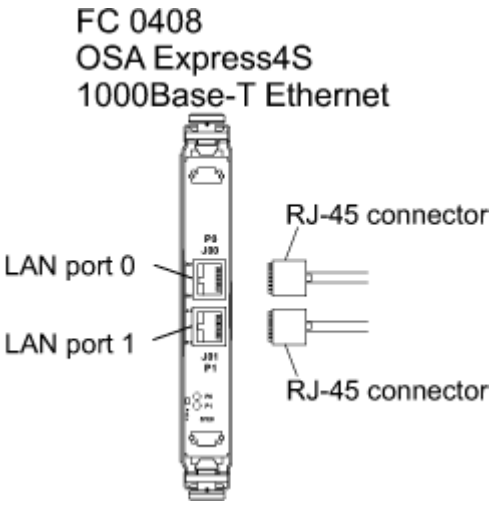


Figure 33. OSA-Express4S features

OSA-Express references

For additional information on planning for OSA features see:

- *Open System Adapter-Express3 Integrated Console Controller Dual-Port User's Guide*
- *Open Systems Adapter-Express Customer's Guide and Reference*
- *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*

I/O interconnect links

A PCIe fanout card (FC 0173) supports one copper cable PCIe 8 GBps interconnect. This connects to the one PCI-IN card in a PCIe I/O drawer. A single PCI-IN card controls an I/O domain that contains eight channel cards.

Coupling features

The 3906 supports the following coupling features. All features can be carried forward or can be purchased on a new build.

Feature code	Description	Maximum # of features	Maximum connections	Order increments per feature	Fiber type	Connector type
FC 0171	HCA3-O	16	32 links	2 links	SX laser 50 micron	MPO
FC 0170	HCA3-O LR	16	64 links	4 links	9 micron single mode	LC Duplex
FC 0172	ICA SR	40	80 links	2 links	SX laser 50 micron	MTP
FC 0433	Coupling Express LR	32	64 links	2 links	9 micron single mode	LC Duplex

The 3906 supports a maximum of 512 coupling CHPIDs (of all types).

HCA3-O feature (FC 0171)

Note: InfiniBand coupling communications using HCA3-O (FC 0171) is not available with Emperor II models.

The HCA3-O feature (FC 0171) supports 12x InfiniBand for coupling communication between systems, and it resides in the GX++ (Infiniband) fanout slot in the CPC drawer. If you are planning to install 12x InfiniBand links, you will have to place connected servers no further than 150 meters (492 feet) from each other.

12x InfiniBand provides up to a 6.0 GBps[1] fiber optic connection between z14, z13, z13s, zEC12, and zBC12 servers. A 12x InfiniBand fiber optic cable (50 micron multimode OM3) connects directly to a port on the HCA3-O fanout card.

The following cables are all duplex 24-fiber cable assemblies, SX laser 50 micron, using MPO connectors on both ends.

Table 53. InfiniBand cable part numbers for FC 0171

Part number	Length meters (feet)
41V2466	10.0 (32.8)
15R8844	13.0 (42.7)
15R8845	15.0 (49.2)
41V2467	20.0 (65.6)
41V2468	40.0 (131.2)
41V2469	80.0 (262.4)
41V2470	120.0 (393.7)
41V2471	150.0 (492.1)
42V2083	Custom (Custom)

Notes:

1. The link data rates, (for example, 6.0 GBps, 8.0 GBps, and 5 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.
2. You must supply InfiniBand cables as you do with other fiber optic systems (FICON, OSA).

HCA3-O LR feature (FC 0170)

Note: InfiniBand coupling communications using HCA3-O LR (FC 0170) is not available with Emperor II models.

The HCA3-O LR feature (FC 0170) supports 1x Long Reach (LR) InfiniBand for coupling communication between systems, and it resides in the GX++ (Infiniband) fanout slot in the CPC drawer. 1x IFB coupling links support a maximum unrepeated distance of 10 kilometers (6.2 miles) and the maximum repeated distance is 100 kilometers (62 miles) when attached to a qualified DWDM.

1x Long Reach (LR) InfiniBand provides up to a 5.0 Gbps[1] fiber optic connection.

A 1x LR InfiniBand fiber optic cable (9 micron single mode) connects directly to a port on the HCA3-O LR fanout card.

Notes:

1. The link data rates, (for example, 6.0 GBps, 8.0 GBps, and 5 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.
2. You must supply InfiniBand cables as you do with other fiber optic systems (FICON, OSA).

Integrated Coupling Adapter (ICA SR) feature (FC 0172)

IBM Integrated Coupling Adapter (ICA SR) feature (FC 0172) supports PCIe Gen3 for coupling communication between systems, and it resides in the PCIe fanout slot in the CPC drawer. If you are planning to install PCIe Gen3 links, you will have to place connected servers no further than 150 meters (492 feet) from each other.

PCIe Gen3 provides up to a 8.0 GBps* fiber optic connection between the z14, z13, and z13s servers. A PCIe Gen3 fiber optic cable (150 m - 50 micron multimode OM4; 100 m - 50 micron multimode OM3) connects directly to a port on the ICA SR fanout card. It is recommended that you order ICA SR cabling through Anixter or IBM Global Technology Services® to get IBM qualified cables. For more information, see *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*.

Note: * The link data rates, (for example, 6.0 GBps, 8.0 GBps, and 5 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

You can order ICA SR (FC 0172) in increments of one feature (2 ports), up to a maximum of 40 features (80 ports).

The following cables are all simplex 24-fiber cable assemblies, SX laser 50 micron, using MTP connectors on both ends.

Table 54. ICA SR cable part numbers for FC 0172

Part number	Length meters (feet)	Cable type
00JA687	8.0 m (26.3 ft)	OM4
00LU282	10.0 m (32.9 ft)	OM4
00LU283	13.0 m (42.7 ft)	OM4
00JA688	15.0 m (49.3 ft)	OM4
00JA689	20.0 m (65.7 ft)	OM4
00LU284	40.0 m (131.3 ft)	OM4
00LU285	80.0 m (262.5 ft)	OM4
00LU286	120.0 m (393.8 ft)	OM4
00LU287	150.0 m (492.2 ft)	OM4
00LU288	custom length < 150.0 m (492.2 ft)	OM4
00JJ548	8.0 m (26.3 ft)	OM3
00LU290	10.0 m (32.9 ft)	OM3
00LU291	13.0 m (42.7 ft)	OM3
00JJ549	15.0 m (49.3 ft)	OM3
00JJ550	20.0 m (65.7 ft)	OM3
00LU292	40.0 m (131.3 ft)	OM3
00LU293	80.0 m (262.5 ft)	OM3
00LU294	100.0 m (328.1 ft)	OM3
00LU295	custom length < 100.0 m (328.1 ft)	OM3

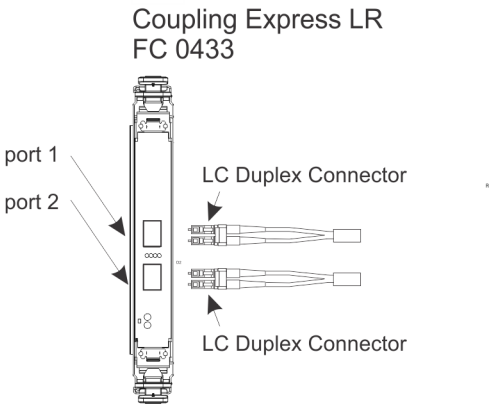
Coupling Express LR feature (FC 0433)

Coupling Express LR feature (FC 0433) supports 10 GbE RoCE for long-distance point-to-point coupling communications between z14, z13, and z13s systems. The Coupling Express LR adapter connects to a card slot in the PCIe I/O drawer.

Coupling Express LR is a two-port, Ethernet-based coupling card with a data rate of 10.0 GBps* and a maximum unrepeated distance of 10 km and a maximum repeated distance of 100 km with a qualified Dense Wavelength Division Multiplexing (DWDM) device. Coupling Express LR utilizes a 9 micron single mode cable that connects to the Coupling Express LR card using LC Duplex connectors on both ends. Coupling Express LR can only connect to another Coupling Express LR. It is recommended that you order Coupling Express LR cabling through IBM Global Technology Services to get IBM qualified cables. For more information, see *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open System Adapters, and zHyperLink Express)*.

Note: * The link data rates, (for example, 6.0 GBps, 8.0 GBps, 5 Gbps, and 10 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

You can order Coupling Express LR in increments of one feature (2 ports), up to a maximum of 32 features (64 ports). Coupling Express LR supports up to four CHPIDs per port.



IBM Virtual Flash Memory (Virtual Flash Memory) (FC 0604)

IBM Virtual Flash Memory (Virtual Flash Memory) (FC 0604) provides up to 6.0 TB of memory in 1.5 TB increments for improved application availability and to handle paging workload spikes.

You can order up to four features. There is 1.5 TB of memory per feature.

Native PCIe adapters

The following features utilize industry standard PCIe adapters (called native PCIe adapters). They physically plug into a mother card that provides Vital Product Data (VPD) and hot-plug capability. The features then plug into the PCIe I/O drawer.

Table 55. Native PCIe adapter feature codes

Feature code	Description
FC 0430	25 GbE RoCE Express2
FC 0411	10 GbE RoCE Express
FC 0412	10 GbE RoCE Express2
FC 0420	IBM zEDC Express
FC 0431	IBM zHyperlink Express
FC 0435	IBM Adapter for NVMe

These native cards do not have CHPID assignments. They have Virtual Functions (VFs) that are defined in IOCP/HCD. PCHIDs/AIDs are still applicable with native cards.

IBM RoCE Express and RoCE Express2

RoCE stands for RDMA (Remote Direct Memory Access) over Converged Ethernet. Using any of the following IBM RoCE Express adapters, RDMA technology is available on Ethernet.

- 25 GbE RoCE Express2
- 10 GbE RoCE Express2
- 10 GbE RoCE Express

RDMA technology provides the capability to allow hosts to logically share memory. An IBM RoCE Express adapter, in conjunction with an OSA card, enables shared memory communications between two CPCs using a shared switch, which is customer supplied.

IBM RoCE Express adapters provide the following:

- Reduce network latency with memory-to-memory transfers utilizing Shared Memory Communications - Remote Direct Memory Access (SMC-R) in z/OS V2.1. It is transparent to applications and can be used for LPAR-to-LPAR communication on a single z/OS system or server-to-server communication in a multiple CPC environment.
- Support single root I/O virtualization (SR-IOV). SR-IOV is a standard specification to help promote interoperability. 10 GbE or 25 GbE RoCE Express2 provide increased virtualization allowing RoCE to be extended to more workloads.
- Support Virtual Functions (VFs)
  - 10 GbE RoCE Express supports 31 Virtual Functions (VFs) per PCHID
  - 10 GbE or 25 GbE RoCE Express2 support 127 Virtual Functions (VFs) per physical port for a total of 254 VFs per PCHID

Notes:

- A CHPID number or CHPID type is not required.
- You can order all IBM RoCE Express adapters in increments of two ports, up to a maximum of 8 ports (4 features). There are two ports per feature.
- IBM RoCE Express adapters require the presence of an IFP processor.

- IBM RoCE Express adapters use existing Ethernet fabric (switches with Global Pause enabled), and requires a standard 10 GbE or 25 GbE switch depending on the speed specified (CEE enabled switch is not required).
- 25 GbE RoCE Express2 requires the connection endpoint to also be 25 GbE RoCE Express2.

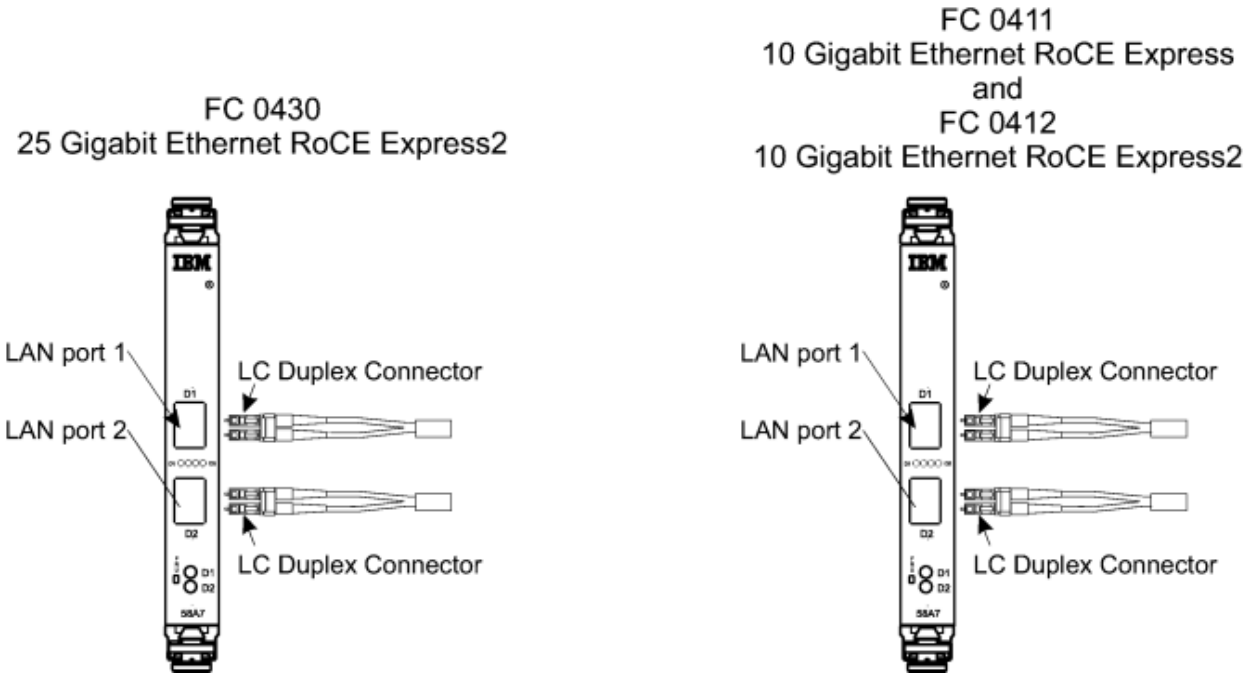


Figure 34. RoCE Express and RoCE Express2 features

zEnterprise Data Compression (zEDC) Express (FC 0420)

The zEDC Express feature and the IBM zEnterprise® Data Compression (zEDC) acceleration capability in z/OS are designed to help improve cross-platform data exchange, reduce CPU consumption, and save disk space. zEDC Express is designed to allow higher write rates for SMF data when hardware compression is enabled. zEDC Express can be shared by up to 15 LPARs.

You can order zEDC Express in increments of one feature, up to a maximum of 8 features. Pairing is not required, but highly suggested for reliability and availability purposes.

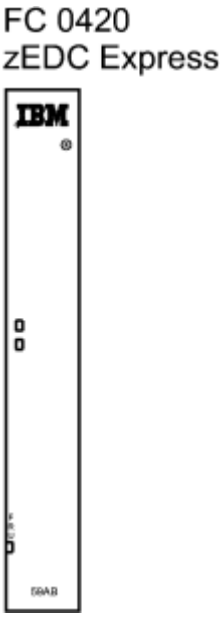


Figure 35. zEDC Express feature

IBM zHyperLink Express (FC 0431)

The zHyperLink Express feature provides the following:

- Improves I/O latency for IBM Z access to disk storage
- Increases scalability of IBM Z transaction processing
- Avoids client re-engineering of applications and middleware
- Allows consolidation of increased work onto z/OS database products
- Potentially lowers software licensing costs when running on IBM storage

With zHyperLink Express:

- Only native LPAR is supported
- All data transfers must be 16-byte aligned and with the length being a multiple of 16 bytes

zHyperLink Express is a 2-port adapter with a data rate of 8.0 GBps and a maximum unrepeated distance of 150 m. You can order the zHyperLink Express feature in increments of one feature. You can have up to sixteen 2-port adapters (32 ports total). Each port can have up to 127 Virtual Functions, which is 127 FIDs. No physical FIDs.

zHyperLink Express requires a customer-supplied 24x MTP-MTP cable for each port. Two fiber type options are available with specifications supporting different distances for zHyperLink Express:

- OM4 and OM5: 50/125 micrometer multimode fiber optic cable with a fiber bandwidth @ wavelength: 4.7 GHz-km @ 850 nm.
- OM3: 50/125 micrometer multimode fiber optic cable with a fiber bandwidth @ wavelength: 2.0 GHz-km @ 850 nm.

For more information about these specifications, see "Integrated Coupling Adapter (24x PCIe) 50 micron multimode physical layer" in *Planning for Fiber Optic Links, GA23-1408*.

This feature resides in a card slot in the PCIe I/O drawer.

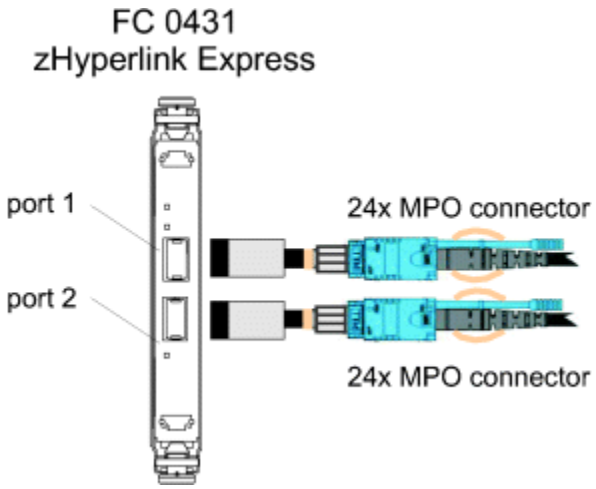


Figure 36. zHyperLink Express feature

IBM Adapter for NVMe (FC 0435)

The IBM Adapter for NVMe (Non-Volatile Memory Express®) feature utilizes NVMe to provide IBM LinuxONE Emperor II fast access to data stored on Solid State Drives (SSDs). NVM Express® is an open collection of standards and information to fully expose the benefits of non-volatile memory in all types of computing environments from mobile to data center. NVMe™ is designed from the ground up to deliver high bandwidth and low latency storage access for current and future NVMe technologies.

IBM Adapter for NVMe details:

- Only available with IBM LinuxONE Emperor II
- A zero port, single PCHID adapter card
- Order in increments of 1 feature, with maximum of 16 features

IBM provides the adapter card into which a vendor NVMe SSD can be plugged. The NVMe SSD is customer supplied and installed into the IBM adapter card by the IBM service representative.

Important:

Once installed, any future servicing of the customer supplied NVMe SSD requires a service contract to be in place. The servicing or replacement of the NVMe SSD by an IBM Service Representative is **not** covered under Warranty or Maintenance Agreement.

Attention: The selection and purchase of the SSDs in this feature is the responsibility of the client. The *IBM LinuxONE NVMe white paper (70019570-USEN-00)* (https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=70019570USEN&) lists the performance of SSDs that IBM has tested for LinuxONE. IBM can only comment on the functionality of the SSDs that have been tested. The client assumes all risk in, and IBM is not responsible for, the use of SSDs as the functionality or performance may vary.

Notes

- Hot plug or removal is **not** supported. Use IBM Service support when installing or removing SSDs.
- The NVMe SSD must meet the following optional specification items:
  - Support 64 bit PCIe addressing
  - Support Host Controlled Thermal Management
  - Support Thermal Throttling
  - Support single port PCIe x4 only
- Linux on Z:
  - Ubuntu 18.04 LTS with service
  - IBM is working with its Linux distribution partners to include support in future distributions releases
- Specifications:
  - NVM Express 1.2b
  - PCI Express Base Specification Rev 3.1
  - Enterprise SSD Form Factor Version 1.0a (Single Port Only)
  - PCI Express Card Electro-Mechanical Spec. Rev 3.0
- Form Factor:
  - U.2 2.5'' (15 mm) Form factor U.2-compatiable connector (formerly SFF-8639)
  - 25W max power consumption

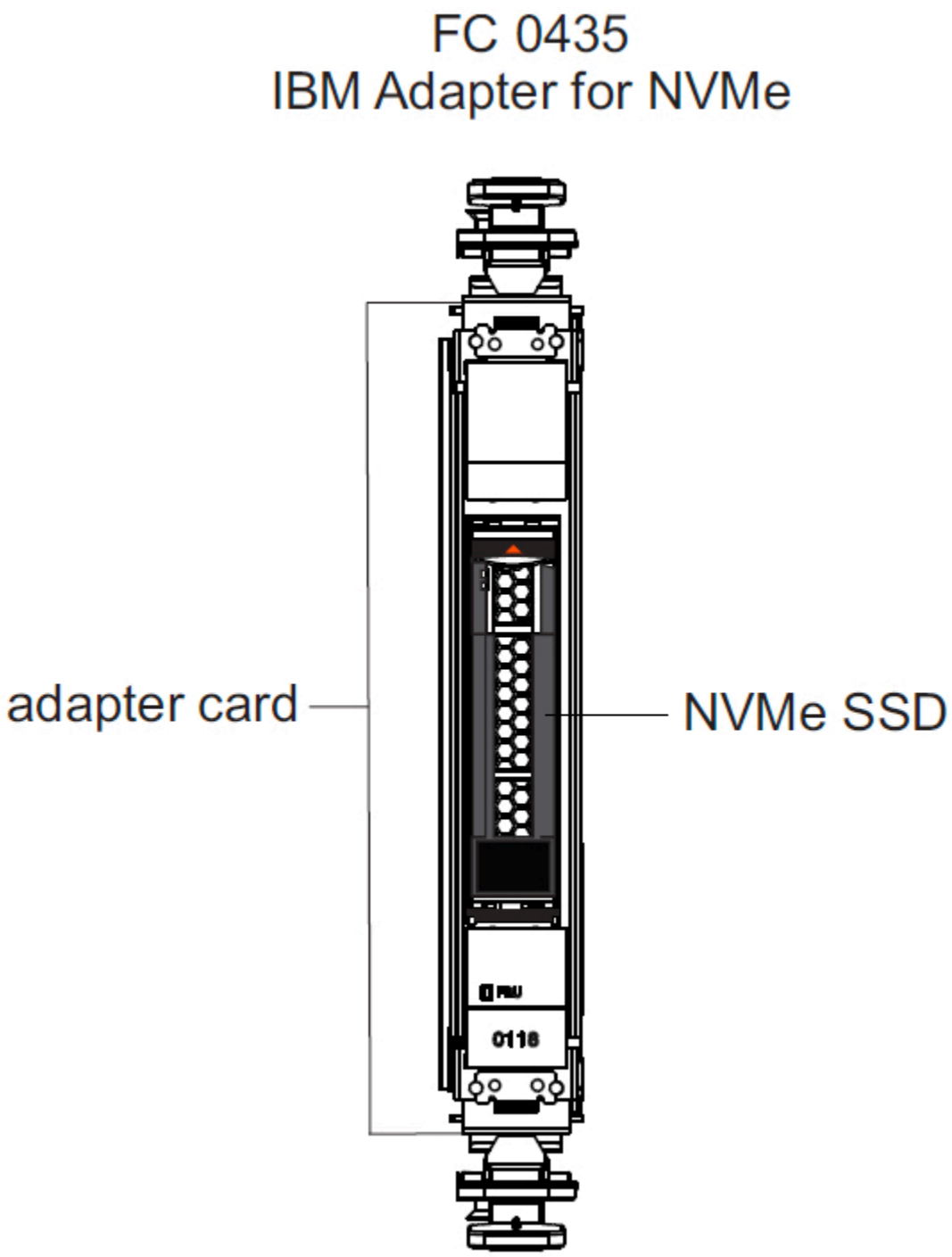


Figure 37. IBM Adapter for NVMe feature

The IBM Adapter for NVMe feature resides in the PCIe+ and PCIe I/O drawer.

Regional Crypto Enablement (RCE) Vendor 1

If Regional Crypto Enablement (RCE) Vendor 1 (FC 0901) was ordered, airflow plates will be installed in the slots in the PCIe I/O drawer designated for the RCE Vendor 1 cards. Before the IBM representative installs any RCE Vendor 1 cards, the following conditions must be satisfied:

- The system must be in "Install Complete" prior to adding the RCE Vendor 1 cards.
- The customer must have a Linux LPAR partition established prior to the installation of the RCE Vendor 1 cards.
- The customer must provide the RCE Vendor 1 cards from a reliable vendor. IBM does not supply these RCE Vendor 1 cards.
- The plug location of each RCE Vendor 1 card must be identified. They will be located in the CHPID report that the customer uses. You can obtain this information directly from the customer or obtain the report from *http://www.ibm.com/servers/resourcelink* (Tools --> CHPID Mapping Tool).

Time synchronization

Synchronized time is possible with a 3906 in a Sysplex environment using Server Time Protocol (STP). STP supports Coordinated Timing Networks (CTNs) where the 3906 in the network are configured to be in STP timing mode.

Server Time Protocol (STP)

Server Time Protocol (FC 1021) requires no special cables to create timing links with other servers. Depending on the distance between servers in a timing network, you may use InfiniBand (HCA3-O (FC 0171) or HCA3-O LR (FC 0170)) fiber optic cables, PCIe Gen3 (ICA SR feature (FC 0172) fiber optic cables, or PCIe Gen3 Coupling Express LR (FC 0433) fiber optic cables to create the Sysplex. z14 or Emperor II can participate in a timing network with z14, Emperor II, z13, Emperor, z13s, Rockhopper, zEC12, and zBC12. z14 or Emperor II only supports STP-only timing networks.

Note: HCA3-O and HCA3-O LR are not available with Emperor II models.

Pulse per second

An STP CTN has the capability of configuring as its time source a Network Time Protocol (NTP) time server that has a pulse per second (PPS) output signal. This type of external time device is available worldwide from several vendors that provide network timing solutions. Typically, the NTP output of the time server is connected to the Support Element (SE) LAN because the NTP client runs on the Support Element. The PPS output of the NTP time server is connected to the PPS input coaxial connector provided on the oscillator card on the 3906.

The following illustration shows the location of the oscillator card on the 3906.

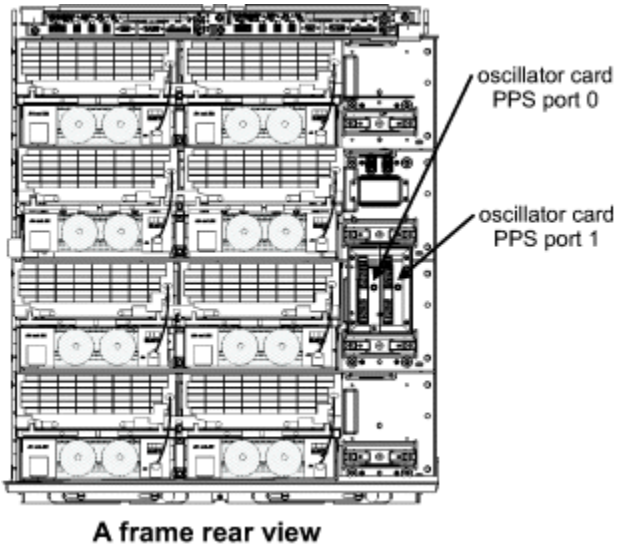


Figure 38. oscillator card location

The pulse per second (PPS) port on the oscillator cards requires a signal with the characteristics listed in Table 56 on page 157. Your network timing solution vendor can assist with the necessary cabling and signal distribution hardware required to meet these characteristics for your specific machine installation.

With a low signal loss PPS distribution, timing solutions can be achieved that exceed 150 feet (45 meters) between the last distribution point and the oscillator card PPS port.

For the input signal received at the oscillator card PPS port, the rise time/fall time of the PPS signal must be shorter as 50 microseconds.

Table 56. PPS signal characteristics				
	Unit of measure	**Minimum**	**Typical**	**Maximum**
Voltage Level LOW	volt	0		0,15
Voltage Level HIGH	volt	3,2		5,2
Rise time	microsecond			50
Fall time	microsecond			50
Pulse width	millisecond	50	125	450

Ordering PPS cables

If you are planning to place this server in an STP-only Coordinated Timing Network using NTP with pulse per second as the external time source, you must supply the coaxial cables that connect the 3906 to the NTP server providing the PPS signal.

Fiber Quick Connect (FQC) for FICON cabling

Fiber Quick Connect harness cabling, harness brackets and mounting hardware are ordered with the 3906 as feature codes. The feature codes are:

Table 57. Fiber Quick Connect feature codes

Fiber Quick Connect (FQC) feature codes - radiator-cooled and water-cooled	
7923	FQC first bracket and mounting hardware
7924	LC Duplex 6.6 ft. harness (FICON) [1]
7925	LC Duplex 8.5 ft. harness (FICON) [2]
7926	LC Duplex 12 ft. harness (FICON) [3]

Notes:

1. from PCIe I/O drawer at Z22, Z15, Z08, Z01
2. from PCIe I/O drawer at rear A32
3. from PCIe I/O drawer at front A32

The Fiber Quick Connect feature enables trunk cables to connect to FICON channels using under-the-cover attachment harnesses. These harnesses are installed when your system is built, and your 3906 arrives ready to connect the trunk cables at your site.

Figure 39 on page 159 shows the Fiber Quick Connect feature hardware.

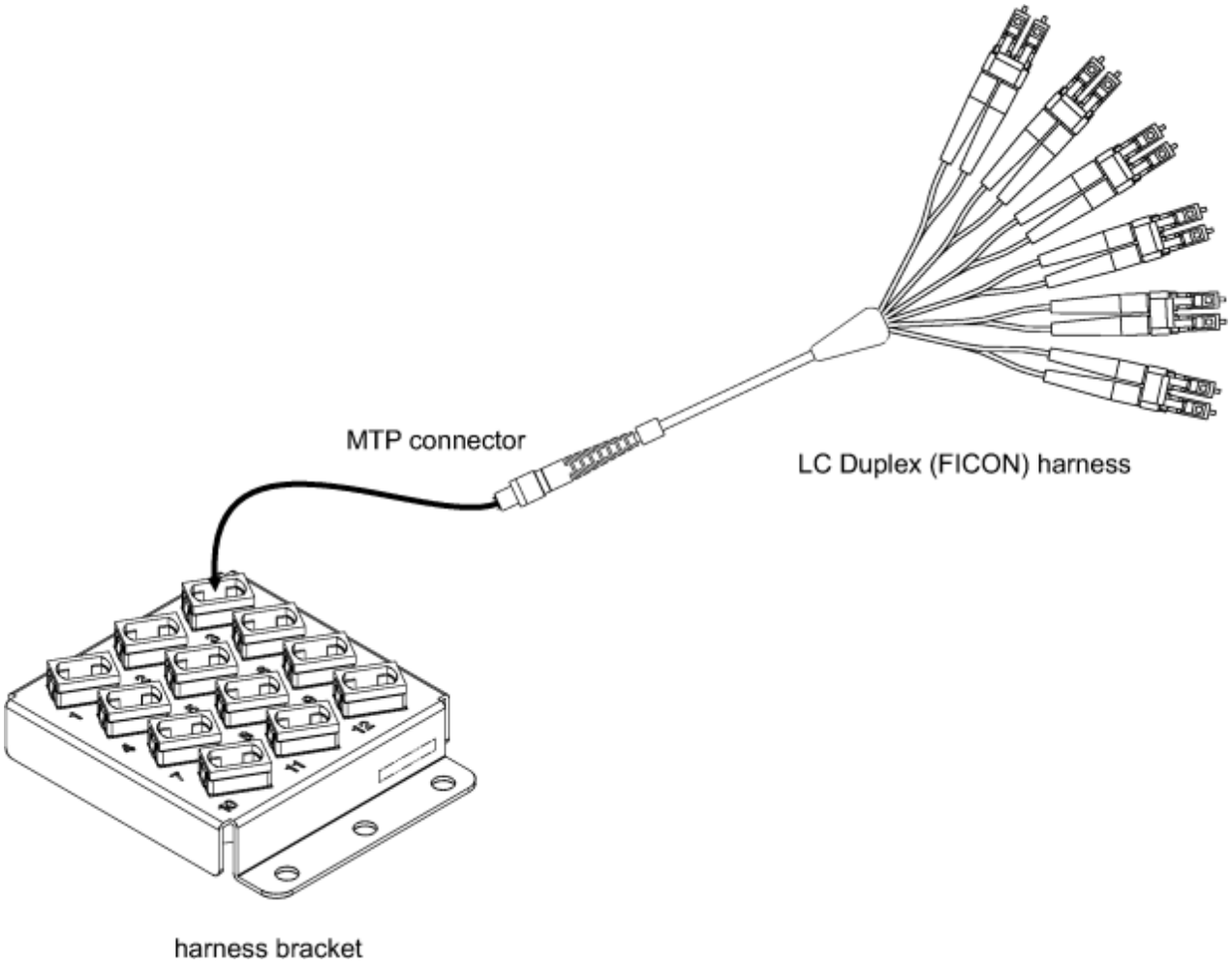
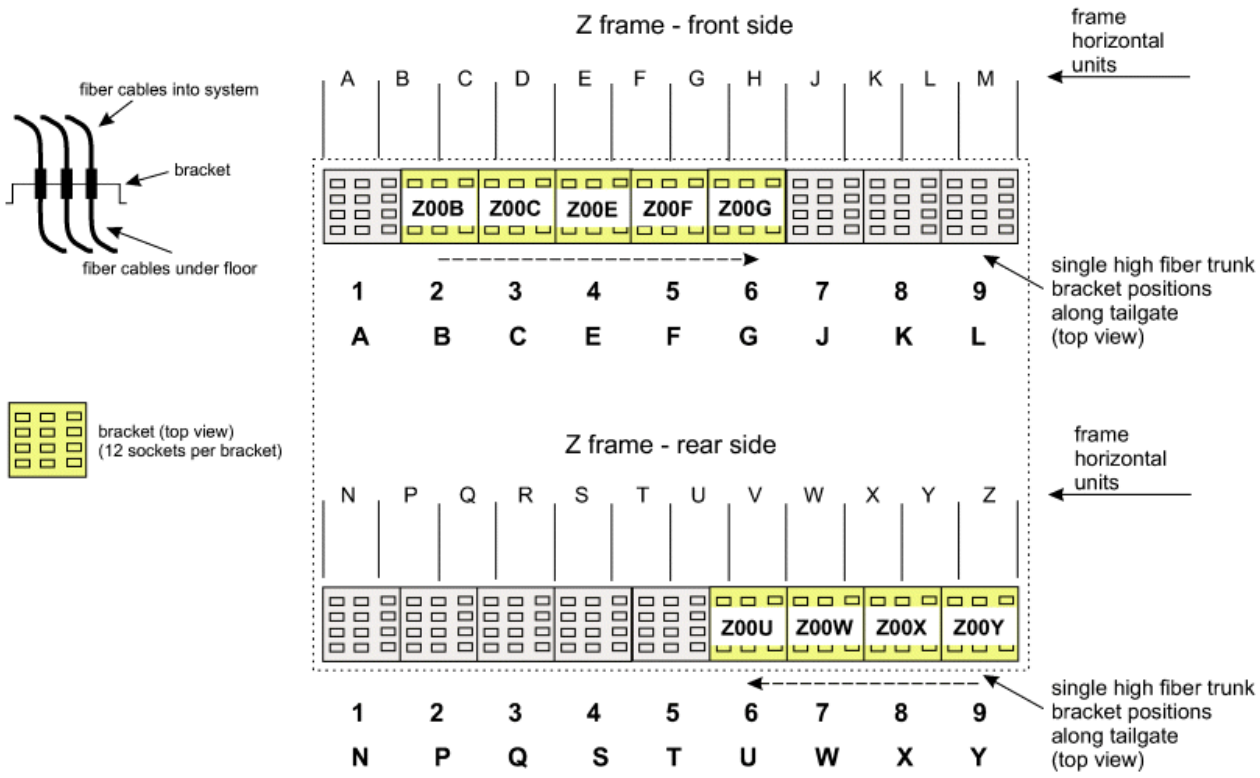


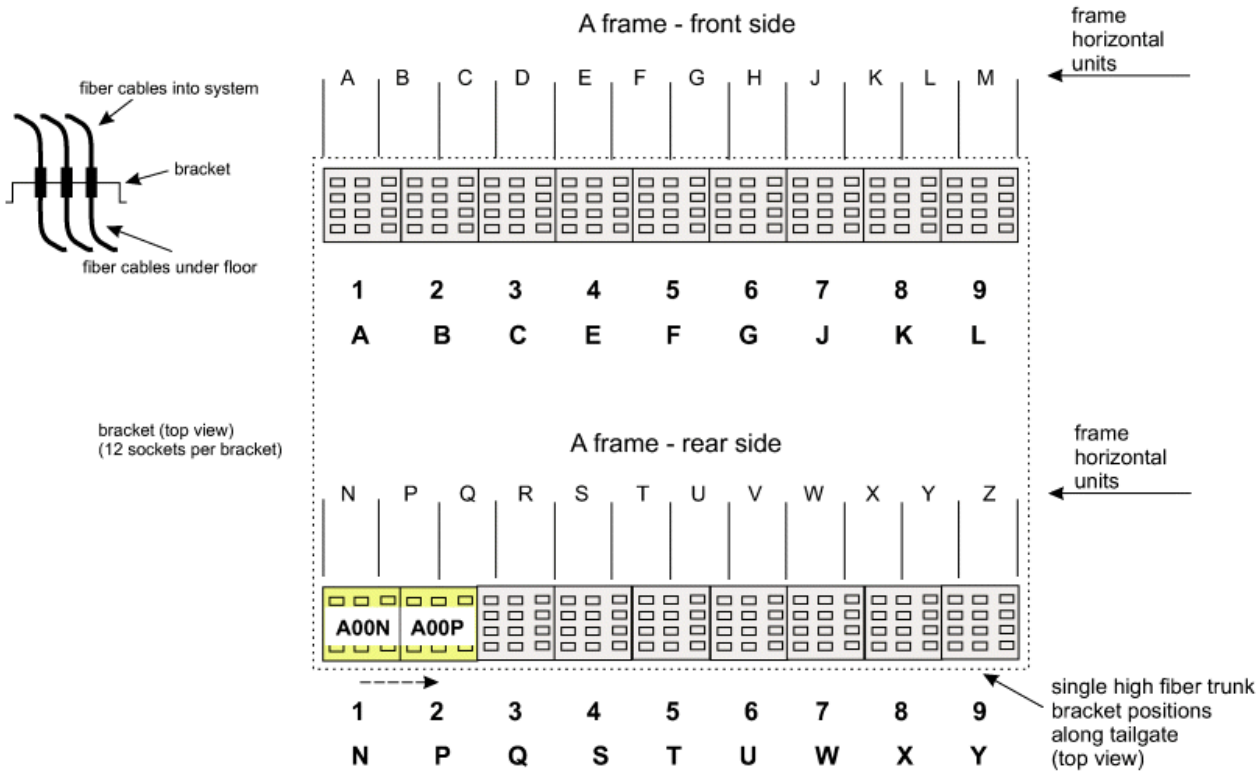
Figure 39. Fiber Quick Connect feature hardware

The harness brackets use an MTP connector, and the FICON connectors are routed to the feature cards in each frame.

The following list shows where the FQC brackets are used, and the order in which they are installed.

- A-frame front - not applicable
- A-frame rear - A00N (1), A00P (2)
- Z-frame front - Z00B (1), Z00C (2), Z00E (3), Z00F (4), Z00G (5)
- Z-frame rear - Z00Y (1), Z00X (2), Z00W (3), Z00U (4)


Z frame - front side
frame horizontal units
A B C D E F G H J K L M
fiber cables into system
bracket
fiber cables under floor
Z00B Z00C Z00E Z00F Z00G
1 2 3 4 5 6 7 8 9
A B C E F G J K L
single high fiber trunk bracket positions along tailgate (top view)
bracket (top view) (12 sockets per bracket)
Z frame - rear side
frame horizontal units
N P Q R S T U V W X Y Z
Z00U Z00W Z00X Z00Y
1 2 3 4 5 6 7 8 9
N P Q S T U W X Y
single high fiber trunk bracket positions along tailgate (top view)


A frame - front side
frame horizontal units
A B C D E F G H J K L M
fiber cables into system
bracket
fiber cables under floor
1 2 3 4 5 6 7 8 9
A B C E F G J K L
bracket (top view) (12 sockets per bracket)
A frame - rear side
frame horizontal units
N P Q R S T U V W X Y Z
A00N A00P
1 2 3 4 5 6 7 8 9
N P Q S T U W X Y
single high fiber trunk bracket positions along tailgate (top view)

Fiber Quick Connect mounting brackets can also be installed at EIA positions 02, 10, and 19 in the I/O top exit cabinets on the Z frame front and Z frame rear. (See Figure 40 on page 161.) Fiber Quick Connect mounting brackets can be installed at EIA positions 02 in the I/O top exit cabinets on the A frame rear. (The harness bracket is installed on the Fiber Quick Connect mounting bracket.)

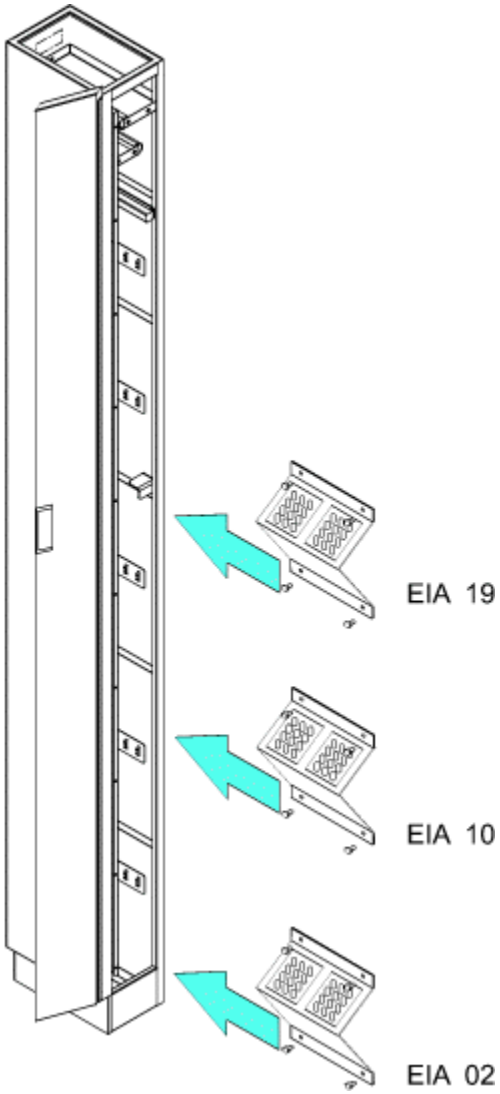


Figure 40. Fiber Quick Connect mounting brackets

If you are planning to use the Fiber Quick Connect feature for FICON channels, contact IBM Site and Facilities Services for assistance. Site and Facilities Services will help you plan for the trunking cabling solution that meets your individual system requirements. Your IBM installation planning representative, IBM product specialist, or IBM service representative will provide you with the information necessary to contact Site and Facilities Services.

Preparing configuration definitions

The customer is responsible for preparing a definition of the I/O configuration for the new processor. You should use the PCHID report from the order process configurator as a guide for planning and defining the new configuration. Depending on the current operating environment there may be several methods for accomplishing this.

z/VM

If you use HCM and HCD, develop the configuration using HCM and HCD. Otherwise, develop the IOCP statements necessary to define your configuration and use the level of the ICP IOCP program that supports the new processor to verify the input statements. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link, to aid you in assigning PCHIDs to CHPIDs. HCM and HCD users must build an IOCP input data set from a validated work IODF and use this as input to the CHPID Mapping Tool. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs.

Note: An IOCP input file that was created by HCM and HCD without PCHIDs must be migrated back into HCM and HCD after PCHID numbers have been added to the file by the CHPID Mapping Tool. An IOCDS can then be written from a production IODF or IOCP statements can be built for the install diskette.

If you are installing a new processor, transfer the IOCP statements for your configuration to a diskette. If necessary, the IOCP input file can be compressed using a zip-compatible program. When the new system arrives, give the diskette containing the IOCP input statements to the install team.

If you are installing a new processor, instead of using a diskette you can remotely write the IOCDS from an HCD that is running on an installed CPC in the same HMC cluster. Inform the install team that plans are in place to use the "Build and manage S/390 microprocessor IOCDSs" option in HCD to write the IOCDS.

z/VSE®

Develop the IOCP statements necessary to define your configuration and use the level of the ICP IOCP program that supports the new processor to verify the input statements. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link, to aid you in assigning PCHIDs to CHPIDs. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs.

If you are installing a new processor, transfer the IOCP statements for your configuration to a diskette. If necessary, the IOCP input file can be compressed using a zip-compatible program. When the new system arrives, give the diskette containing the IOCP input statements to the install team.

z/OS HCD

Develop the configuration using HCD. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link, to aid you in assigning PCHIDs to CHPIDs. Build an IOCP input data set from a validated work IODF and use this as input to the CHPID Mapping Tool. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs. Migrate the modified IOCP input file back into HCD after PCHID numbers have been added to the file by the CHPID Mapping Tool. An IOCDS can then be written in preparation for an upgrade using a production IODF.

Note: An IOCP input file that was created by HCD without PCHIDs must be migrated back into HCD after PCHID numbers have been added to the file by the CHPID Mapping Tool. An IOCDS can then be written from a production IODF or IOCP statements can be built for the install diskette.

If you are installing a new processor, build an IOCP input data set for your configuration from a production IODF and transfer the IOCP statements to a diskette. In the unlikely event that the IOCP input file exceeds the capacity of the diskette, the IOCP input file can be compressed using a zip-compatible program. When the new system arrives, give the diskette containing the IOCP input statements to the install team.

If you are installing a new processor, instead of using a diskette you can remotely write the IOCDS from an HCD that is running on an installed CPC in the same HMC cluster. Inform the install team that plans are in place to use the "Build and manage S/390 microprocessor IOCDSs" option in HCD to write the IOCDS.

Dynamic I/O for Standalone Coupling Facility enables dynamic activation of a new or changed IODF on a standalone coupling facility CPC, without requiring a re-IML or power-on reset (POR). This capability requires z14 GA2 firmware support on the coupling facility CPC as well as the CPC where the HCD system is running. If you are planning to use the Dynamic I/O for Standalone Coupling Facility capability on a CPC, you must use HCD to configure your IODF/IOCDS appropriately for that CPC. No IODF/IOCDS updates are required on the CPC where the HCD itself is running. For more information, see *z/OS HCD User's Guide, SC34-2669*.

Chapter 9. Parallel sysplex planning

This chapter is intended to provide guidance to those customers who operate in a Parallel Sysplex environment. A Parallel Sysplex typically involves multiple processors and coupling facilities, shared I/O devices, and a host of interconnection possibilities. Detailed planning for a Parallel Sysplex is essential to meet technical objectives, such as performance and high availability, within the constraints of a specific raised floor configuration. Consider using IBM Site and Facilities Services to plan your sysplex environment. A list of tasks the Service can perform is provided under "IBM Site and Facilities Services" on page 137. Different technologies for servers, links and coupling facilities affect your ability to configure a productive sysplex.

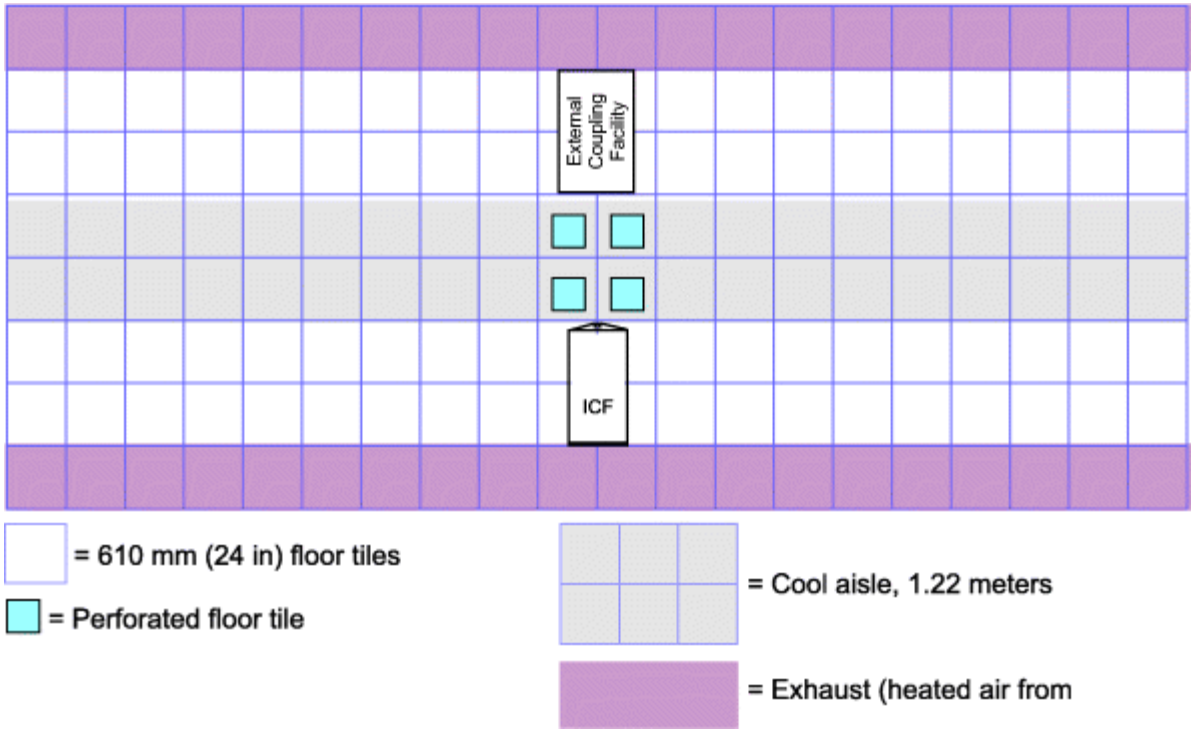
The basic premise for a successful Parallel Sysplex installation is to centralize the physical location of the coupling facilities, and then position the sysplex servers around that center. Servers can be placed side-to-side. In addition to bringing the servers closer to the coupling facility, placing your server side-to-side provides for better management of hot and cold air flow.

Notes:

1. z14 can only participate in an STP-only timing network. z14 cannot participate in a Mixed timing network where ANY system is connected to a Sysplex Timer.
2. z14 can only communicate directly with z14, z13, z13s, zEC12, and zBC12.

Following are some guidelines to help you better plan for multiple system interconnection. These are example configurations that would minimize the distance to the coupling facility.

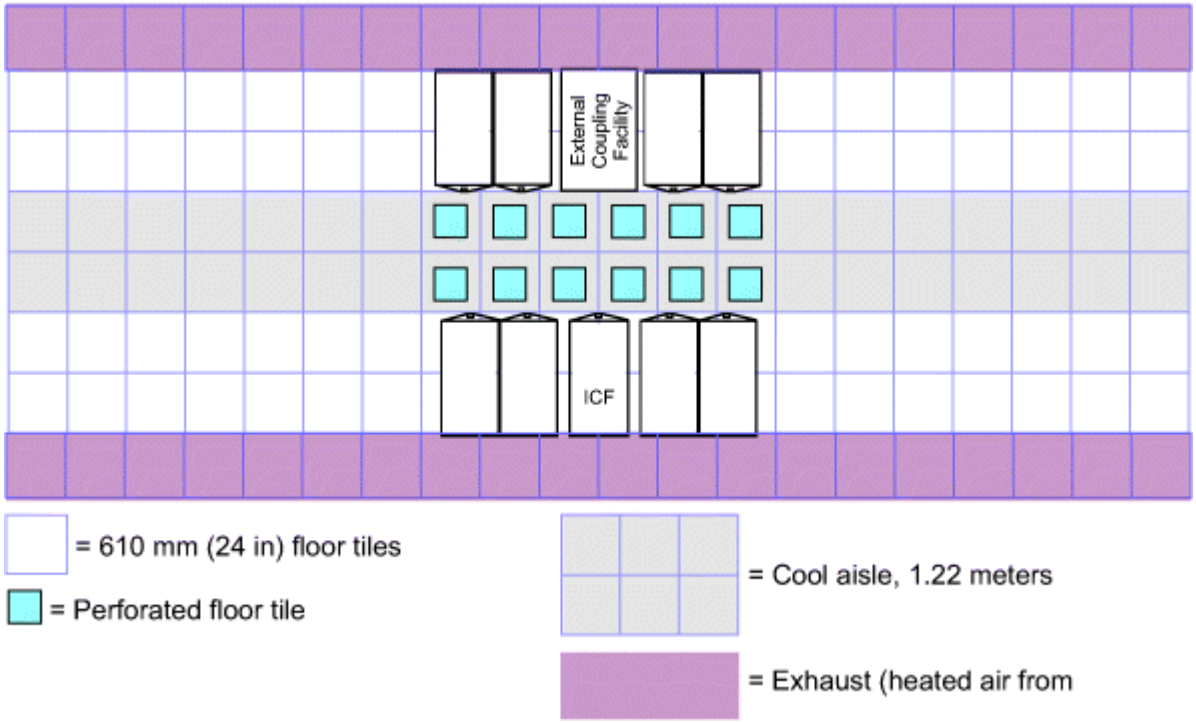
1. Position the coupling facilities (or servers with internal coupling facilities) in the center of an open area of raised floor large enough to accommodate all of the servers and other coupling facilities to which you want to connect.



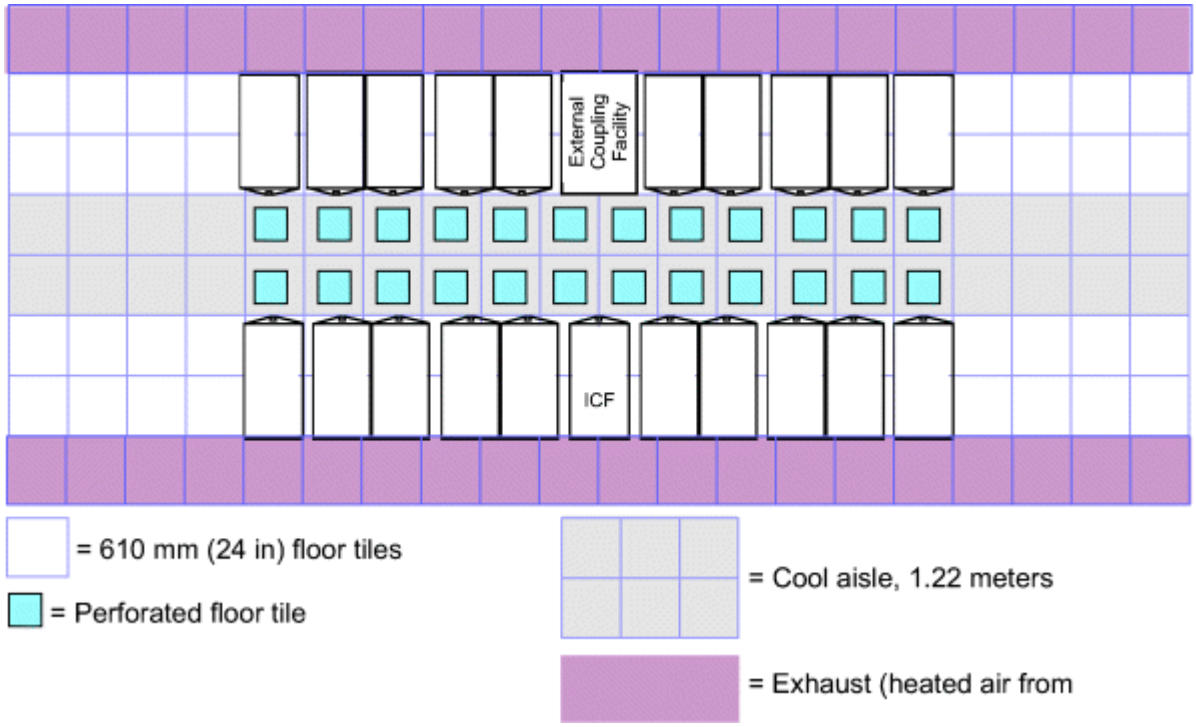
   - Use physical planning information for each type of server/coupling facility you intend to add to the Parallel Sysplex to help determine how much floor space you will need.
   - Remember to consider weight distribution, service clearances, power, and cooling for each piece of equipment you want to include.

2. Arrange the sysplex in two rows, with the fronts of servers and coupling facilities facing each other (see the illustration under "Weight distribution and multiple systems" on page 72). Allow a 1168.4 mm (46 in) aisle width between the rows. Although this may be a larger aisle than you have used before, your Parallel Sysplex will benefit from the improvement in cooling that a wider aisle provides. (See Figure 18 on page 79.)

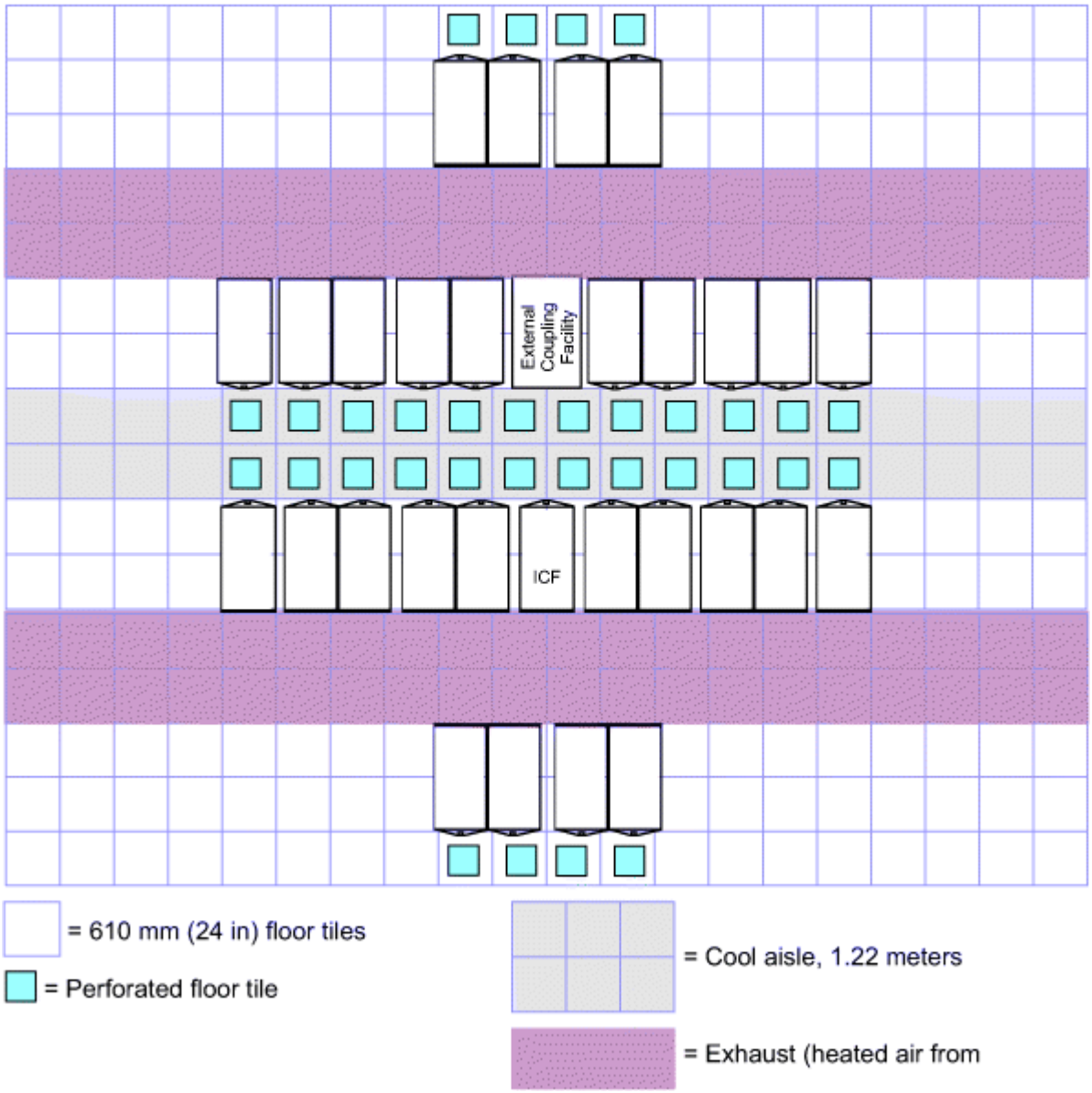
   Note: Figure 18 on page 79 shows a minimum aisle width of 939.8 mm (37 in). Although this width is adequate for a congested computer room floor, it is the **minimum** you should use. An aisle 1168.4 mm (46 in) wide will better serve the cooling and cabling needs of a Parallel Sysplex configuration.



3. Sysplex connections can be made using InfiniBand, Coupling Express LR, or ICA SR link cabling.
4. As the Parallel Sysplex grows, add new servers evenly on either side of the central coupling facilities.

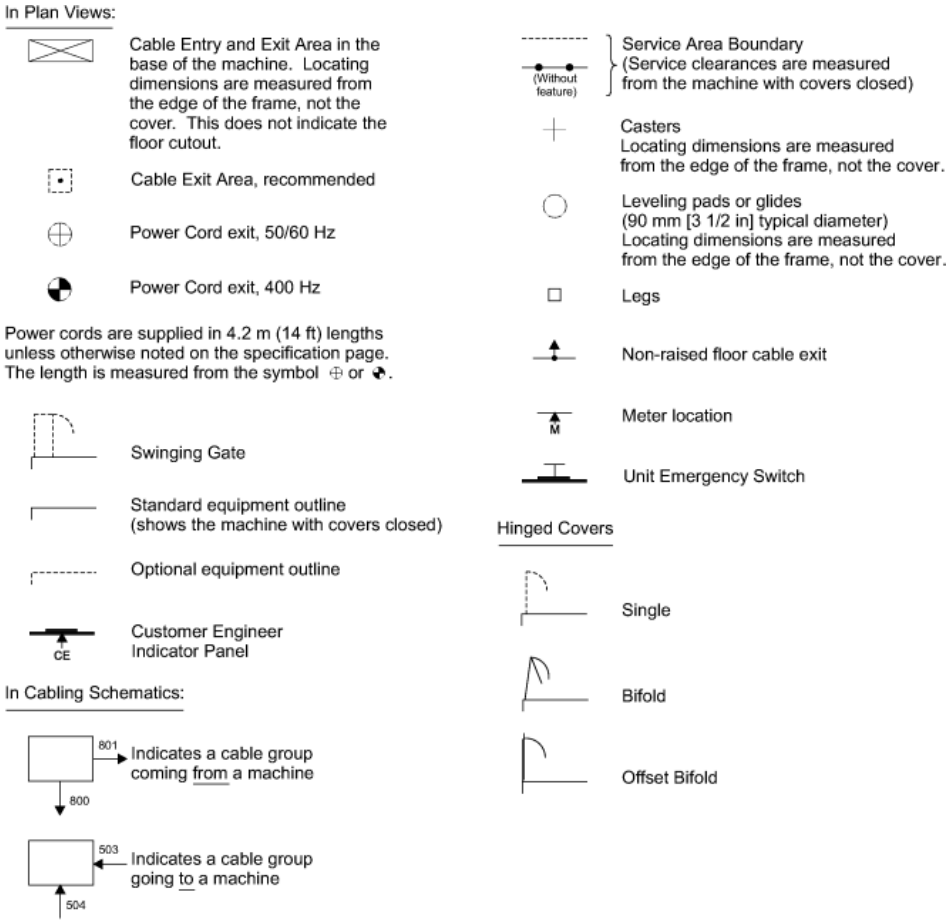


5. As the Parallel Sysplex evolves, it is possible to add rows using InfiniBand, Coupling Express LR, or ICA SR link cabling, which provide connectivity over greater distances than previous links. With the equipment in these new rows centered on the original central coupling facilities, the Parallel Sysplex now assumes the shape of a diamond.



By following these guidelines, you will be able to configure a Parallel Sysplex, using the minimum amount of floor space, that meets your performance and availability objectives. The use of technology combinations - z14, z13, z13s, zEC12, and zBC12 servers and coupling facilities may complicate your physical planning, but the basic strategies outlined here will result in a successful Parallel Sysplex environment.

Appendix A. IBM standard symbols



Appendix B. Hardware Management Console physical specifications

This section contains information for the Hardware Management Console components applicable at the time of publication (determined by the edition notice at the front of this document). Specifications for your Hardware Management Console may differ from those presented below.

Notes for FC 0083 and FC 0096 and FC 0094:

- When planning to use the rack mounted HMC (FC 0083), HMC (FC 0096) or HMC (FC 0094), you must provide the rack where the HMC and console unit (holding the keyboard and display) are installed. It is recommended that you install the rack-mounted HMC below the keyboard/display in the customer-provided rack.
- For USA and Canada, the HMC (FC 0083), HMC (FC 0096), and HMC (FC 0094) uses two PDU plug positions for the two AC power supplies in the server. (Other power requirements are country dependent.)
- Do not block any air vents; usually 15 cm (6 in) of space provides proper airflow.
- Do not leave open spaces above or below an installed server in your rack cabinet. To help prevent damage to server components, always install a blank filler panel to cover the open space and to help ensure proper air circulation.
- Install the server only in a rack cabinet with perforated doors.
- Plan the device installation starting from the bottom of the rack cabinet.
- Install the heaviest device in the bottom of the rack cabinet.
- Do not extend more than one device out of the rack cabinet at the same time.
- Connect the server to a properly grounded outlet.
- Do not overload the power outlet when you install multiple devices in the rack cabinet.
- For FC 0083 and FC 0096, install the server in a rack that has a minimum depth of 28.25 in (720 mm) and maximum depth of 30 in (762 mm).
- For FC 0094, install the server in a rack that meets the following requirements:
  - Minimum depth of 70 mm (2.76 in) between the front mounting flange and inside of the front cover.
  - Minimum depth of 157 mm (6.18 in) between the rear mounting flange and inside of the rear cover.
  - Minimum depth of 718 mm (28.27 in) and maximum depth of 762 mm (30 in) between the front and rear mounting flanges to support the use of the cable management arm.

  The maximum distance between the front and the rear EIA rails of the rack is 810 mm (31.9 in).

Table 58. Hardware Management Console (FC 0083 and FC 0096) specifications	
FC 0083 and FC 0096 - Hardware Management Console system unit specifications	
Dimensions	
Height	4.45 cm (1.75 in)
Width	48.26 cm (19 in)
Depth	71.12 cm (28.0 in)
Weight maximum configuration	15.97 kg (35.2 lb)
Input Power[1]	
Low range input voltage	90 Vrms - 137 Vrms
High range input voltage	180 Vrms - 265 Vrms
Input frequency range	47 - 63 Hz
Input kilovolt-amperes (kVA) (approximate)	
Minimum configuration	0.134 kVA
Maximum configuration	0.988 kVA
Environmentals	
Server On	
Temperature	0° to 40° C (32° to 104° F)
Humidity, non-condensing:	
Dew point	-12° C (10.4° F)
Relative humidity	5% - 90%
Storage (non-operating)	
Temperature	-40° to 70° C (-40° to 158° F)
Relative humidity	5% - 100%
1. Power consumption and heat output vary with the number and type of optional features installed and the power-management optional features in use.	

Table 59. Hardware Management Console (FC 0094) specifications	
FC 0094 - Hardware Management Console system unit specifications	
Dimensions	
Height	43 mm (1.7 in.)
Width	429 mm (16.9 in.)
Depth	734 mm (28.9 in.)
Weight maximum configuration	16.4 kg (36.16 lbs.)
Input Power[1]	
Low range input voltage	100 VAC - 127 VAC
High range input voltage	200 VAC - 240 VAC
Input frequency range	50 - 60 Hz
Input kilovolt-amperes (kVA) (approximate)	
Minimum configuration	0.14 kVA
Maximum configuration	0.90 kVA
Output Power[1]	
Heat output in British thermal units (Btu) (approximate)	
Minimum configuration	461 Btu/hr (135 watts)
Maximum configuration	2900 Btu/hr (850 watts)
Environmentals	
Server On	
Temperature with altitude: 0 to 950 m (3117 ft)	5° to 40° C (41° to 104° F)
Temperature with altitude: greater than 950 m (3117 ft)	derated 1°C (33.8° F) per 175 m (575 ft)
Temperature at maximum altitude 3050 m (10,007 ft)	5° to 28° C (41° to 82.4° F)
Humidity, non-condensing:	
Dew point	-12° C (10.4° F)
Relative humidity	8% - 85%
Maximum dew point	24° C (75.2° F)
Server Off	
Temperature	5° to 45° C (41° to 113° F)
Relative humidity	8% - 85%
Maximum dew point	27° C (80.6° F)
Storage (non-operating)	
Temperature	1° to 60° C (33.8° to 140° F)
Altitude	3050 m (10,007 ft)

Table 59. Hardware Management Console (FC 0094) specifications (continued)	
FC 0094 - Hardware Management Console system unit specifications	
Relative humidity	5% - 80%
Maximum dew point	29° C (84.2° F)
Shipping (non-operating)	
Temperature	-40° to 60° C (-40° to 140° F)
Altitude	10,700 m (35,105 ft)
Relative humidity	5% - 100%
Maximum dew point	29° C (84.2° F)
1. Power consumption and heat output vary with the number and type of optional features installed and the power-management optional features in use.	

Notes for FC 0082 and FC 0095:

Review the following guidelines about the 2461 HMC (FC 0082 and FC 0095):

- When installing the chassis, ensure that a minimum free air space is available around the system. The installation should have a minimum of 4 in -6 in (101 mm -152 mm) behind the chassis and 7 in - 8 in(178 mm - 203 mm) in front of the chassis. Any front cabinet doors or access aisles must accommodate a 2461 HMC (FC 0082 and FC 0095) front chassis clearance of at least 7.0 in (178 mm) in order to provide proper clearance for the fan FRU. Ideally, a chassis clearance of 0.5 in -1.5 in (13 mm -38 mm) above the system is desirable.
- The 2461 HMC (FC 0082 and FC 0095) system is designed with ruggedness in mind, however, precautions should be observed to ensure safe and reliable performance. Place the chassis on a flat, stable surface capable of supporting both the system weight and any anticipated peripherals. Installation area should be secure and free from danger of liquid or airborne contaminants that could damage internal components as well as supporting all airflow requirements.
- To protect internal components from electrostatic damage, be sure to observe the following precautions when handling or storing the system:
  - The 2461 HMC (FC 0082 and FC 0095) has a net chassis weight of approximately 41.0 lbs. (18.59 kg). Use proper lifting techniques when moving and installing the system.
  - When removing or installing boards and sub-components, keep these components in their static-shielded bag and/or packaging until you are ready to for component installation.
  - Handle the sub-components by their edges.
  - Do not touch any sub-component I/O connector pins. Do not apply pressure or attach labels to the board-level subcomponents.
  - Use a personal grounding system, such as a wrist or heel strap(s) or ground yourself frequently by touching the metal chassis of the system before handling any subcomponents.
  - Ensure the systems external power source has a solid connection to an earth ground.
  - Use antistatic padding on all work surfaces when installing or removing subcomponents.
  - Avoid static-inducing carpeted areas.

Table 60. Hardware Management Console (FC 0082 and FC 0095) specifications

CPU:	Environment:	Electrical input:
• 3.2 GHz Intel Xeon E3-1225 v3 **Memory:** • Minimum: 32 GB • Maximum: 32 GB • Type: DDR3, ECC • Slots: 4 • Supports: 32 GB **Optical drive:** • Slim-line DVD drive **Hard drive:** • 1 TB SATA hard drive **Video:** • AST2400 **Fans:** • Two side-removable hot-swap fans **Power supply:** • One 900-watt AC **Integrated function:** • Six Intel l350 Ethernet ports • One Intel l210 management Ethernet port • Eight USB ports	**Operating:** • Temperature: 0ºC - 40ºC (32ºF - 104ºF) • Altitude: 3050 m (~10,000 ft) • Relative humidity: 5% - 90% @ -12ºC (10.4ºF) dew point, non-condensing **Storage (non-operating):** • Temperature: -40ºC - 70ºC (-40ºF - 158ºF) • Relative humidity: 5% - 100% **Air flow:** • 350LFM continuous airflow **Size:** • Height: 439.2 mm (17.29 in) • Depth: 492.25 mm (19.38 in) • Width: 215.9 mm (8.5 in) • Weight: approximately 18.59 kg (41.0 lb)	• Sine-wave input (47-63 Hz) required • Input voltage low range: – Minimum: 90 Vrms – Maximum: 137 Vrms • Input voltage high range: – Minimum: 180 Vrms – Maximum: 265 Vrms • Input kilovolt-amperes (kVA), approximately: – Minimum: 0.134 kVA – Maximum: 0.988 kVA

Notes for FC 0092: When planning the work area for the Hardware Management Console, remember to allow a suitable space for a full-size keyboard, flat panel display, and mouse.

Table 61. Hardware Management Console (FC 0092) specifications	
FC 0092 - Hardware Management Console system unit specifications	
Dimensions	
Height	425 mm (16.74 in.)
Width	176 mm (6.93 in.)
Depth	635 mm (25.00 in.)
Weight minimum configuration as shipped	20.0 kg (44.10 lbs.)
Weight maximum configuration	29.7 kg (65.48 lbs.)
Input Power[1]	
Low range input voltage	100 VAC - 127 VAC
High range input voltage	200 VAC - 240 VAC
Input frequency range	50 - 60 Hz
Input kilovolt-amperes (kVA) (approximate)	
Minimum configuration as shipped	0.12 kVA
Maximum configuration	0.90 kVA
Output Power[1]	
Heat output in British thermal units (Btu) (approximate)	
Minimum configuration	392 Btu/hr (115 watts)
Maximum configuration	2900 Btu/hr (850 watts)
Environmentals	
Server On	
Temperature with altitude: 0 to 950 m (3117 ft)	5° to 40° C (41° to 104° F)
Temperature with altitude: greater than 950 m (3117 ft)	derated 1°C (33.8° F) per 175 m (575 ft)
Temperature at maximum altitude 3050 m (10,007 ft)	5° to 28° C (41° to 82.4° F)
Humidity, non-condensing:	
Dew point	-12° C (10.4° F)
Relative humidity	8% - 85%
Maximum dew point	24° C (75.2° F)
Server Off	
Temperature	5° to 45° C (41° to 113° F)
Relative humidity	8% - 85%
Maximum dew point	27° C (80.6° F)
Storage (non-operating)	

Table 61. Hardware Management Console (FC 0092) specifications (continued)	
FC 0092 - Hardware Management Console system unit specifications	
Temperature	1° to 60° C (33.8° to 140° F)
Altitude	3050 m (10,007 ft)
Relative humidity	5% - 80%
Maximum dew point	29° C (84.2° F)
Shipping (non-operating)	
Temperature	-40° to 60° C (-40° to 140° F)
Altitude	10,700 m (35,105 ft)
Relative humidity	5% - 100%
Maximum dew point	29° C (84.2° F)
1. Power consumption and heat output vary with the number and type of optional features installed and the power-management optional features in use.	

Notes for 1U console unit (keyboard/display tray):

- The following are recommendations for placement of the 1723-8BX keyboard/display unit into the customer supplied rack:
  - If you are standing when using the 1723-8BX keyboard/display unit, place the unit in EIU locations 21, 22, or 23.
  - If you are sitting when using the 1723-8BX keyboard/display unit, place the unit in EIU locations 12, 13, or 14.
  - For special accommodations, you need to make adjustments in the placement of the 1723-8BX keyboard/display unit in the rack that meet your needs.
- For USA and Canada, the 1723-8BX keyboard/display unit uses one PDU plug position for the AC power supply in the keyboard/display. (Other power requirements are country dependent.)
- Elevated operating ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment might be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.
- Reduced air flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.
- Mechanical loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
- Circuit overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.
- Reliable earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (for example, use of power strips).

Table 62. 1U standard console, type 1723-8BX specifications	
1U standard console, type 1723-8BX specifications	
Dimensions	
Height	44 mm (1.75 in) (display in stored position)
Width	434 mm (17 in) (main chassis only, slide-rails not included, faceplate not included)
Depth	434 mm (17 in) (chassis behind EIA mounting flange, bezel in front of EIA flange not included, cable-management arm not included)
Weight	10.4 kg (23 lb)
LCD panel	
Size	18.5-inch diagonal
Display area (horizontal x vertical)	409.8 x 230.4 mm
Type	TFT active matrix
Pixel pitch (horizontal x vertical)	300 x 300 per triad
Input Power	
Input voltage	100 VAC - 240 VAC
Input frequency range	47 - 63 Hz
Power Consumption	
Normal operation	17 watts
Active off	< 1 watt (at 100 VAC and 240 VAC)
Environmentals - Temperature	
Operating	0° to 50° C (32° to 122° F)
Storage	-20° to 60° C (-4° to 140° F)
Environmentals - Humidity	
Operating	10% to 80%
Storage	5% to 95%

Table 63. Flat panel display specifications

Flat panel display specifications			
	L2251x - Flat panel display 558.7 mm (22.0 inch) (FC 6096)	**LT2323p - Flat panel display 584.2 mm (23.0 inch)**	**T2324p - Flat panel display 584.2 mm (23.0 inch)**
Dimensions			
Height	406.0 mm (15.98 in)	403.9 mm (15.90 in)	472.5 mm (18.60 in) [1]
Width	514.4 mm (20.25 in)	547.8 mm (21.57 in)	545.8 mm (21.49 in)
Depth	239.8 mm (9.44 in)	186.0 mm (7.32 in)	264.1 mm (10.39 in)
Weight with stand	6.2 kg (20.5 lbs)	5.74 kg (12.65 lbs)	5.40 kg (11.90 lbs)
Input Power			
Input voltage	100 VAC - 240 VAC (+/- 10%)	100 VAC - 240 VAC (+/- 10%)	100 VAC - 240 VAC (+/- 10%)
Input frequency range	50/60 Hz + or - 3 Hz	50/60 Hz + or - 3 Hz	50/60 Hz + or - 3 Hz
Rated Current	1.5 amps	1.5 amps	1.5 amps
Power Consumption			
Normal operation	< 45 watts	< 20 watts	< 21 watts (typical) < 49 (maximum)
Standby/ Suspend	< 2 watts (analog or digital)	< 0.5 watts (analog or digital)	< 0.5 watts (analog or digital)
Active off	< 1 watt (at 100 VAC and 240 VAC)	< 0.5 watt (at 100 VAC and 240 VAC)	< 0.3 watt (at 100 VAC and 240 VAC)
Environmentals - Temperature			
Operating	10° to 45° C (50° to 113° F)	0° to 40° C (32° to 104° F)	0° to 45° C (32° to 113° F)
Storage	-20° to 60° C (-4° to 140° F)	-20° to 60° C (-4° to 140° F)	-20° to 60° C (-4° to 140° F)
Shipping	-20° to 60° C (-4° to 140° F)	-20° to 60° C (-4° to 140° F)	-20° to 60° C (-4° to 140° F)
Environmentals - Humidity			
Operating	10% to 80%	10% to 80%	10% to 80%
Storage	5% to 90%	5% to 95%	5% to 95%
Shipping	5% to 90%	5% to 95%	5% to 95%

Notes:

1. This measurement is the distance from the tabletop to the top of the panel using the supplied stand.

Appendix C. 3-phase dual power installation

The 3906 models are designed with a fully redundant power system. Each computer has two or four line cords attached to two or four power input ports which, in turn, power a pair of fully redundant power distribution systems within the computer. To take full advantage of the redundancy/reliability that is built into the computer system, the server **must** be powered from two or more distribution panels.

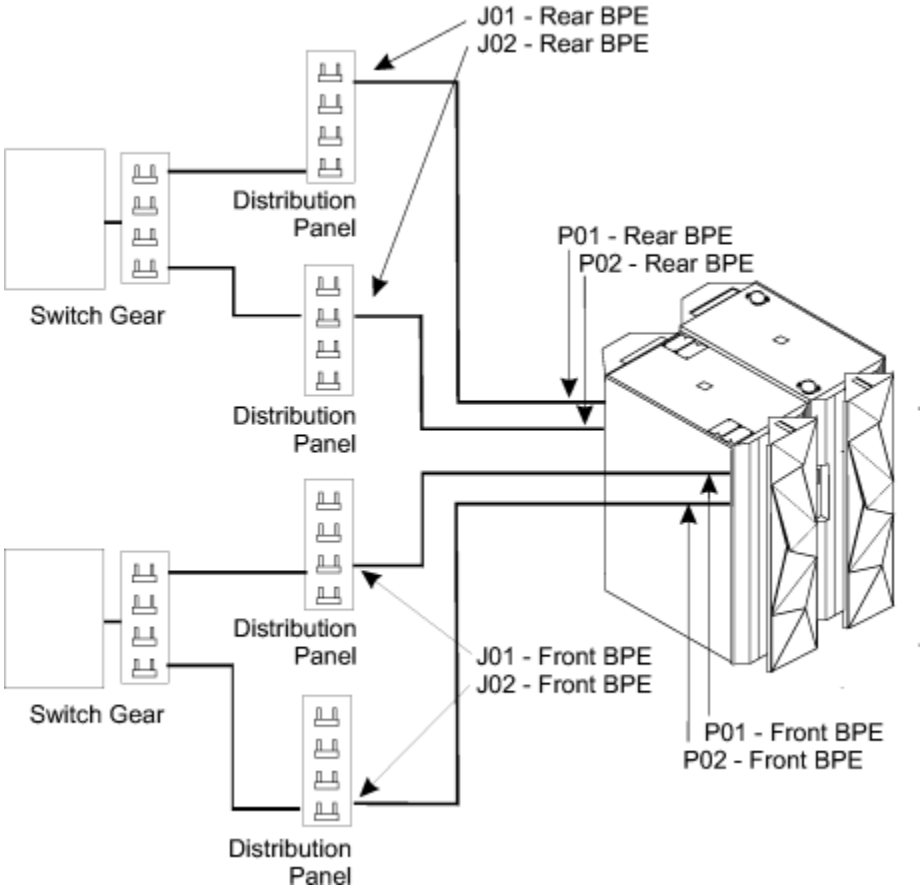
The following shows four examples of redundancy. In these examples, up to four power cords are identified.

- **P02 - Front BPE** and **J02 - Front BPE** are the labels identifying the ends of one of the power cords. **P02 - Front BPE** is the label identifying the end of the power cord that connects to the bottom BPE jack in the front of the frame and **J02 - Front BPE** is the label identifying the end of the same power cord that connects to the customer power distribution unit.
- **P02 - Back BPE** and **J02 - Back BPE** are the labels identifying the ends of one of the power cords. **P02 - Back BPE** is the label identifying the end of the power cord that connects to the bottom BPE jack in the back of the frame and **J02 - Back BPE** is the label identifying the end of the same power cord that connects to the customer power distribution unit.
- **P01 - Front BPE** and **J01 - Front BPE** are the labels identifying the ends of one of the power cords. **P01 - Front BPE** is the label identifying the end of the power cord that connects to the top BPE jack in the front of the frame and **J01 - Front BPE** is the label identifying the end of the same power cord that connects to the customer power distribution unit.
- **P01 - Back BPE** and **J01 - Back BPE** are the labels identifying the ends of one of the power cords. **P01 - Back BPE** is the label identifying the end of the power cord that connects to the top BPE jack in the back of the frame and **J01 - Back BPE** is the label identifying the end of the same power cord that connects to the customer power distribution unit.

Example 1 (redundant distribution panel and switch gear)

In this example, the computer receives power from four separate power distribution panels. The four distribution panels receive power from two pieces of building switch gear.

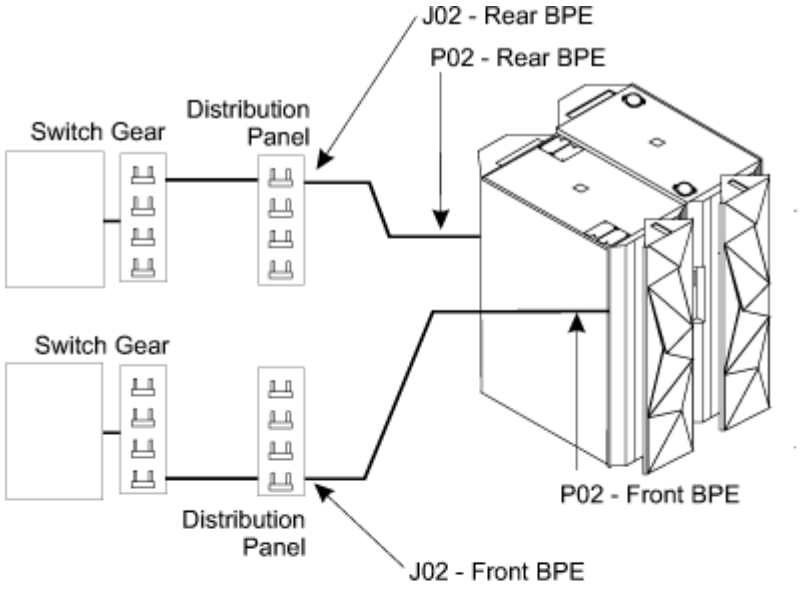
This type of power distribution will not result in system outage in the event of a power failure at either switch gear or one of the distribution panels. To achieve the highest availability, this power distribution is recommended.

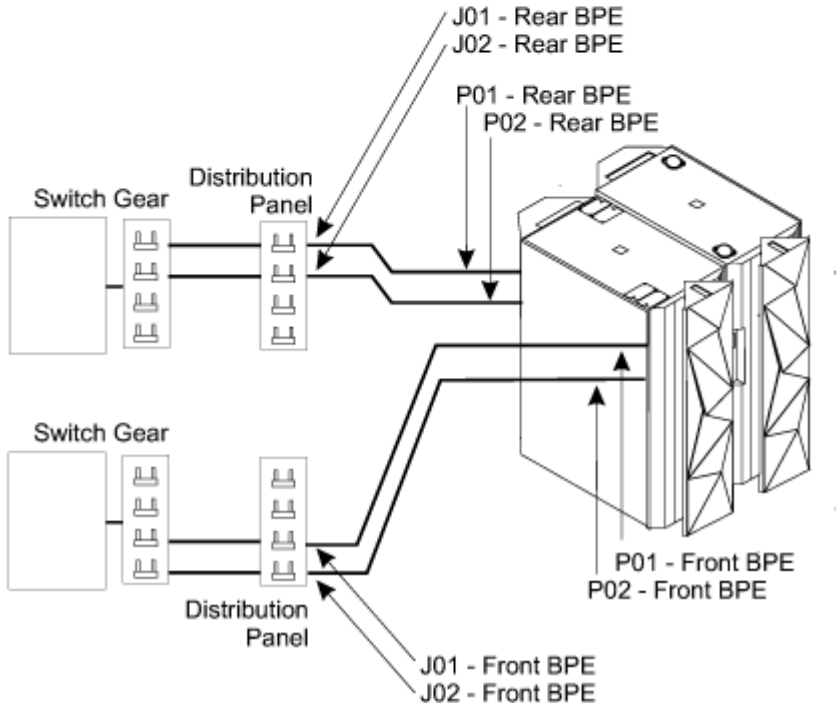


Example 2 (redundant distribution panel and switch gear)

In this example, the computer receives power from two separate power distribution panels. Each distribution panel receives power from a separate piece of building switch gear.

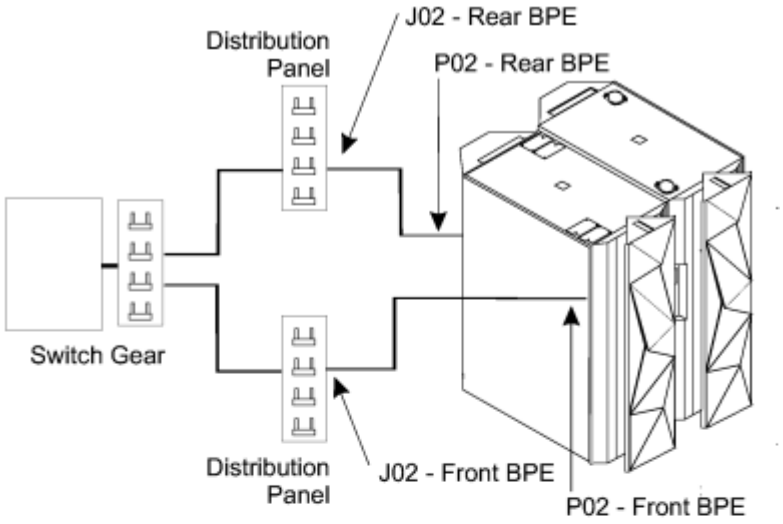
This type of power distribution will not result in system outage in the event of a power failure at either switch gear or either distribution panels.

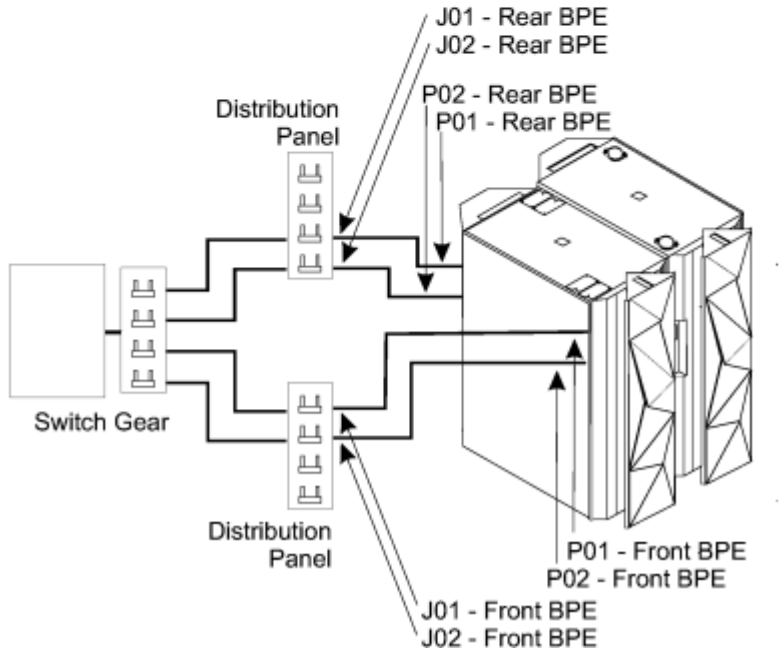




Example 3 (redundant distribution panel)

In this example, the computer receives power from two separate power distribution panels. The two distribution panels receive power from the same piece of building switch gear. Most facilities should be able to achieve this level of redundancy. In this case, loss of switch gear (building power) will result in system outage, but loss of one distribution panel will not.

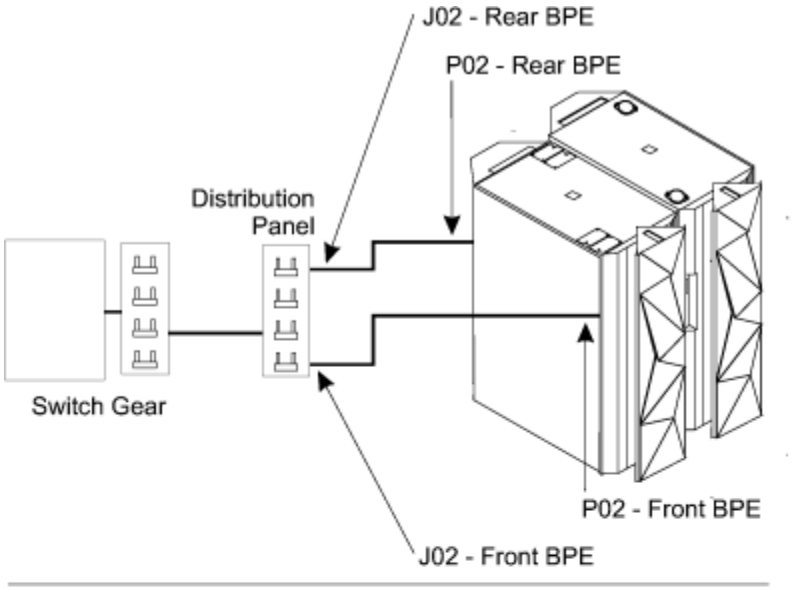


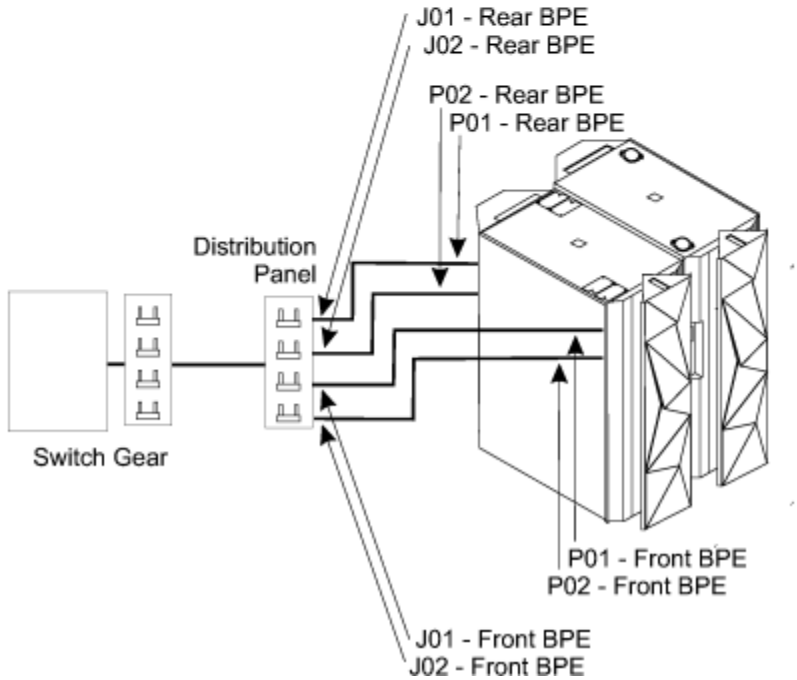


Example 4 (single distribution panel)

In this example, the computer receives power from two or four separate circuit breakers in a single power panel. This does not make use of the redundancy provided by the processor. It is, however, acceptable if a second power distribution panel is not available.

This type of power distribution will result in system outage in the event of a power failure at either the switch gear or the distribution panel. This power distribution is least recommended.





Appendix D. Balancing power panel loads

The 3906 models require three phase power. Depending on the system configuration, the phase currents can be fully balanced or unbalanced. For each possible configuration (processor and I/O combinations), any given system presents a balanced or unbalanced load. If several unbalanced system configurations are fed from the same power panel, the load on that panel will be unbalanced. Two phase currents will be equal and both will be, nominally, 57.8% of the current on the third phase. Figure 41 on page 189 is an example of feeding several loads of this type from two power panels in a way that balances the load among the three phases.

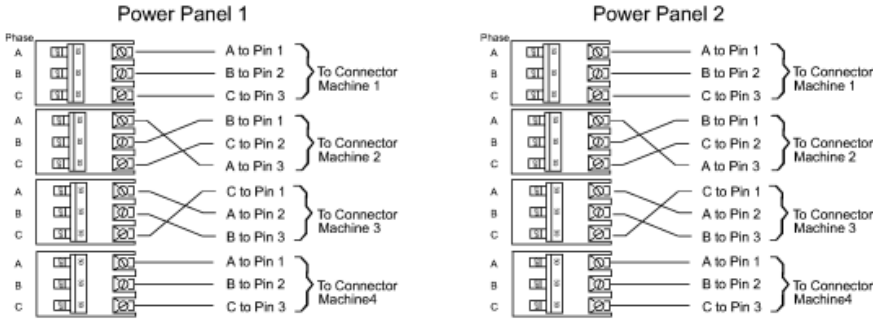


Figure 41. Power load balancing - three-pole breakers

The method in Figure 41 on page 189 requires that the connection from the three poles of each breaker to the three phase pins of a connector be varied. Some electricians may prefer to maintain a consistent wiring sequence from the breakers to the connectors. Figure 42 on page 189 shows a way to balance the load without changing the wiring on the output of any breakers. The three-pole breakers are alternated with single-pole breakers. This way the three-pole breakers don't all begin on Phase A.

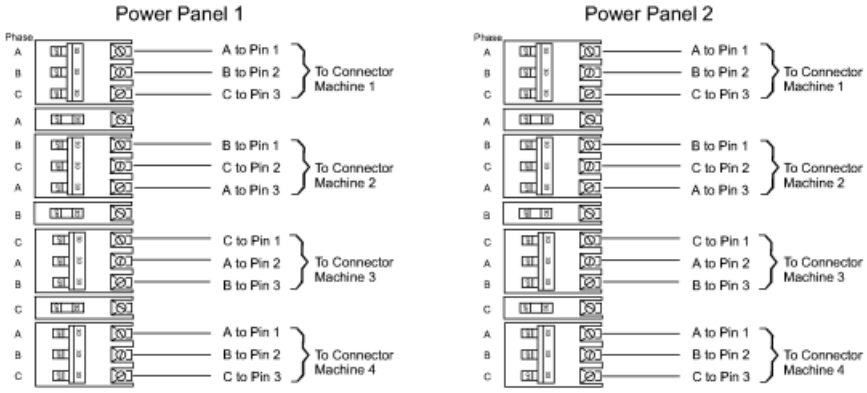


Figure 42. Power load balancing - alternating three-pole and single-pole breakers

Figure 43 on page 190 shows another way of distributing the unbalanced load evenly. In this case, the three-pole breakers are alternated with two-pole breakers.

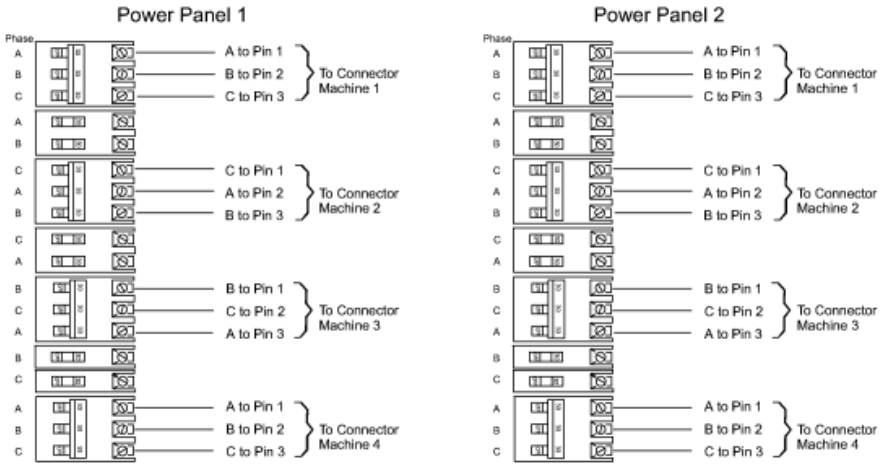


Figure 43. Power load balancing - alternating three-pole and double-pole breakers

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European Community contact:
IBM Deutschland GmbH
Technical Regulations, Department M372

IBM-Allee 1, 71139 Ehningen, Germany
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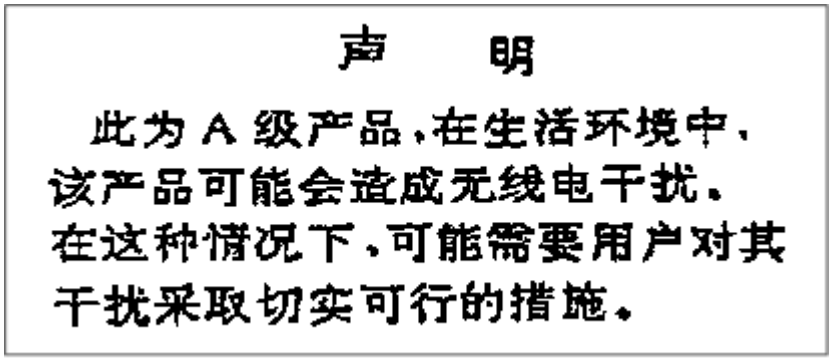

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