zEnterprise 196

Installation Manual for Physical Planning 2817

GC28-6897-02

Level 02f

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Note:
Before using this information and the product it supports, read the information in "Safety" on page v, Appendix H, "Notices," on page 139, and *IBM Systems Environmental Notices and User Guide*, Z125-5823.

| This edition, GC28-6897-02, applies to the IBM System zEnterprise 196 (z196) server. This revision replaces
| GC28-6897-01,

There may be a newer version of this document in a PDF file available on **Resource Link**.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 IBM® product, you must first become familiar with the related safety information in the *IBM Systems Environmental Notices and User Guide*. 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 System z® models can use I/O cards such as, ESCON®, FICON®, Open Systems Adapter (OSA), InterSystem Channel-3 (ISC-3), 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 IBM zEnterprise 196.

- Chapter 1 provides an introduction to planning for your system and a planning checklist.
- Chapter 2 contains important computer room environmental information.
- Chapter 3 gives plan views, service clearances, weight distribution, and cooling information for the system.
- Chapter 4 contains information on preparation of the raised floor.
- Chapter 5 provides power and internal battery feature information.
- Chapter 6 includes information on Hardware Management Console and Support Element communications.
- Chapter 7 contains remote support facility installation planning.
- Chapter 8 discusses cable connectivity information.
- Chapter 9 provides information to build a Parallel Sysplex.
- The Appendices provide IBM standard symbols, environmental specifications, acoustics, power installation and power loads, a sample cabling schematic and upgrade paths.

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

Revisions

Technical changes to the text are indicated by a vertical bar (|) to the left of the change.

Related publications

For related publications, go to Resource Link® at *http://www.ibm.com/servers/resourcelink*. Select **Library** on the navigation bar on the left. Select the server product.

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

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 zEnterprise 196 and is copyrighted and licensed by IBM. Each zEnterprise 196 server 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 z196 requires that the Licensed Machine Code be reinstalled in the server at the new location. The procedure for relocating a z196, “Discontinuing the System,”is in the *zEnterprise 196 Installation Manual*.

Accessibility

This publication is in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties using this PDF file you can request a web-based format of this publication. 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 request, 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.

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Summary of changes

Summary of changes for the *zEnterprise 196 Installation Manual for Physical Planning*, GC28-6897.

Table 1. Summary of changes

Release level	Date	Changes in level
02f	10/2013	This revision contains editorial changes and the following technical changes: • Updated graphics in Appendix D, "3-phase dual power installation," on page 123.

Chapter 1. Introduction to physical planning

This chapter is intended to help you prepare your physical site for the installation of a zEnterprise 196 server. 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 start up.

The use of the terms, “server”, “processor”, “system” and “all models” in this publication refer to the IBM zEnterprise 196.

Throughout this document, air-cooled refers to refrigerated air-cooled models of the 2817. Water-cooled refers to chilled water-cooled models.

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 z196 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

General Information for Planning a Physical Site, on **Resource Link** / **Planning** / **Physical Planning** / **zSeries & S/390®** at *http://www.ibm.com/servers/resourcelink* provides a detailed step-by-step procedure for physically planning a computer room installation.

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, modems, switches, telephones, connection panels, etc	☐	_____	_____
○ In the Chapter titled, “Cabling and Connectivity” (in this document), read the information about planning now for future cabling needs. In the same chapter, read also about “zSeries Fiber Cabling 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 / zSeries” on Resource Link (*http://www.ibm.com/servers/resourcelink*)	☐	_____	_____
○ Order communication equipment cables, modems, switches, telephones, connection panels, etc	☐	_____	_____
○ Order channel equipment cables, directors, switches, patch panels, etc. In the Chapter titled, “Cabling and Connectivity” (in this document), read the information about “zSeries Fiber Cabling Services” 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 and ESCON channels.	☐	_____	_____
○ If you are planning for a system that will use ESCON or FICON channels, InfiniBand, coupling links, or Open System Adapters (OSA), contact your IBM marketing representative to obtain the document, *Fiber Optic Planning (ESCON, FICON, Coupling Links, and Open System Adapters*, GA23-0367	☐	_____	_____
○ Order other machines/devices, including changes to any existing equipment	☐	_____	_____

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	☐	_____	_____
○ 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 IBM 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	☐	_____	_____
○ 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 and modems	☐	_____	_____

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?	☐	_____	_____
○ 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).	☐	_____	_____

General Installation Manual for Physical Planning

Information contained on IBM's Resource Link at *http://www.ibm.com/servers/resourcelink* may be helpful in planning for your raised floor. See "General Information for Planning a Physical Site".

The *General Installation Manual for Physical Planning* covers the following topics:

Site Installation Coordinator
- Oversees the installation
- Selects contractors and vendors
- Sets and maintains the schedule

Site Selection
- Utility availability
- Environmental considerations
- External access to the site
- Internal access within the site
- External and internal facilities
- Expansion potential

Flooring
- Non-raised floor construction
  - Floor coverings in data center
  - Static electricity
- Raised floor construction
  - Vertical underfloor space
  - Sealed floor
  - Floor panel weight capacity
  - Pedestal system
  - Stringers
  - Grounding
  - Cabling provision
  - Expansion Potential

Emergency Planning
- Monitor environment
  - Computer room
  - Air conditioning equipment
  - Electrical supply
- Periodic inspections
- Hazard prevention/protection
  - Fire
  - Water
  - Lightning
  - Chemical
- Personnel training
  - Emergency plans
  - Emergency equipment
  - Emergency shutdown
  - Emergency evacuation
  - Emergency contacts
- Alarms
- Disaster backup plans

Space and Layout
- Obstacles (walls, columns, etc)
- Weight distribution
- Floor loading
- Machine area
- Service clearance
- Cable placement
  - Restrictive cable lengths
- Power access
- Safety equipment
- Facilities access
- Operator space and facilities
- Work flow
  - Entrances/exits
  - Loading dock access
  - Hallways/doorways
  - Ramps
- Lighting
- Acoustics
- Electro Magnetic Interference
- Proximity to hazards
  - Potential water damage
  - Shock and vibration
  - Chemical hazards
  - Fire danger
  - Lightning protection
- Office space
- Storage space
- Supplies space

Power Considerations
- Dual power installation
  - Proper phase rotation
  - Proper wire size and color
- Watertight power connectors
- Proper grounding
- Adequate circuit breakers
- Emergency power shutoff
  - EPO switch
  - UEPO switch
- Backup system power
  - Uniterruptible power supply
  - Surge protection
  - Brownout protection
  - Lightning protection
- Emergency lighting
- Service and utility outlets
- Obvious labeling

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.

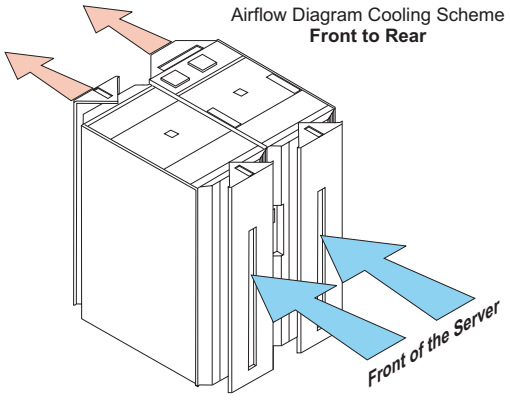
ASHRAE declarations - Air-cooled

ASHRAE Declarations (Metric) for 2817 (Air-cooled)

ASHRAE Class 1 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 10)	Maximum Dry Bulb Temperature (3, 10)	Maximum Dew Point (10)
	kBTU	m3/hr	m3/hr	kg	W x D x H (cm)	m	C°	C°
Minimum Configuration Model M15 FC 1125	20.4	1801.8	2552.5	991	156.5 x 180.3 x 201.3	3048	32	17
Maximum Configuration Model M80 FC 1129	92.8	4504.4	5839.1	2177	156.5 x 180.3 x 201.3	3048	32	17

ASHRAE Declarations (English) for 2817 (Air-cooled)

ASHRAE Class 1 Description	Typical Heat Release	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 10)	Maximum Dry Bulb Temperature (3, 10)	Maximum Dew Point (10)
	kBTU	cfm	cfm	lbs	W x D x H (in)	ft	F°	F°
Minimum Configuration Model M15 FC 1125	20.4	1080	1530	2185	61.6 x 71.0 x 79.3	10,000	89	62.6
Maximum Configuration Model M80 FC 1129	92.8	2700	3500	4799	61.6 x 71.0 x 79.3	10,000	89	62.6



Notes:

1. Airflow is designed to increase as the local ambient room temperature increases. Nominal airflow assumes 25° C (77° F) ambient. Maximum airflow is based on an ambient of 32° C (89° F) for all models.
2. Weights provided assume the optional Integrated Battery Features are installed.
3. For ambient temperatures exceeding 25° C (77° F), the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See Appendix C, "Acoustics," on page 121 for the declared acoustical noise emission levels for the system under nominal temperature conditions of 23° C plus or minus 2° C (73.4° F plus or minus 3.6° F).
4. Maximum ambient reduces 1° C (1.8° F) for every 300 m (984 ft) over 900 m (2953 ft).
5. Weights are approximately maximum for populated frames except where indicated below.
6. Weights do not include covers which add approximately 68 kg (150 lbs) to each frame.
7. The side frame extenders for I/O top exit will add approximately 95 lbs to each frame.

8. The side frame extenders for I/O top exit will add 305 mm (12 inches) to the width and 139.7 mm (5.5 in) to the height.
9. At inlet air temp 28° C (82.4° F), air cooling is 100%.
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.

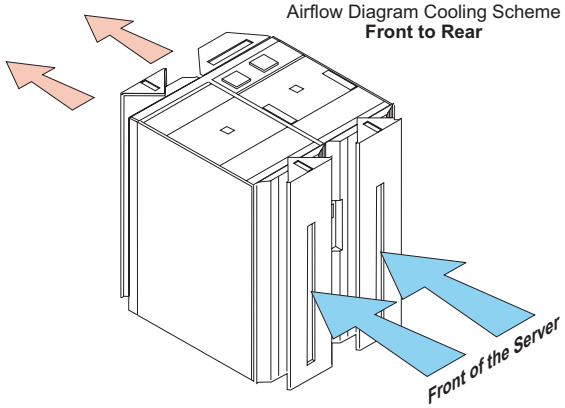
ASHRAE declarations - Water-cooled

ASHRAE Declarations (Metric) for 2817 (Water-cooled)

ASHRAE Class 1 Description	Typical Heat Release (10)	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7, 9)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 11)	Maximum Dry Bulb Temperature (3, 11)	Maximum Dew Point (11)
	kBTU	m3/hr	m3/hr	kg	W x D x H (cm)	m	C°	C°
Minimum Configuration Model M15 FC 1130	19.8	1384.7	1968.6	1133	156.5 x 190.5 x 201.3	3048	32	17
Maximum Configuration Model M80 FC 1134	81.2	3570.2	4554.5	2358	156.5 x 190.5 x 201.3	3048	32	17

ASHRAE Declarations (English) for 2817 (Water-cooled)

ASHRAE Class 1 Description	Typical Heat Release (10)	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7, 9)	Overall System Maximum Dimensions (8)	Maximum Elevation (4, 11)	Maximum Dry Bulb Temperature (3, 11)	Maximum Dew Point (11)
	kBTU	cfm	cfm	lbs	W x D x H (in)	ft	F°	F°
Minimum Configuration Model M15 FCs 1130	19.8	830	1180	2498	61.6 x 75.0 x 79.3	10,000	89	62.6
Maximum Configuration Model M80 FCs 1134	81.2	2140	2730	5261	61.6 x 75.0 x 79.3	10,000	89	62.6



Notes:

1. Airflow is designed to increase as the local ambient room temperature increases. Nominal airflow assumes 25° C (77° F) ambient. Maximum airflow is based on an ambient of 32° C (89° F) for all models.
2. Weights provided assume the optional Integrated Battery Features are installed.
3. For ambient temperatures exceeding 25° C (77° F), the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See Appendix C, "Acoustics," on page 121 for the declared acoustical noise emission levels for the system under nominal temperature conditions of 23° C plus or minus 2° C (73.4° F plus or minus 3.6° F).
4. Maximum ambient reduces 1° C (1.8° F) for every 300 m (984 ft) over 900 m (2953 ft).
5. Weights are approximately maximum for populated frames except where indicated below.
6. Weights do not include covers which add approximately 68 kg (150 lbs) to each frame.

7. The side frame extenders for I/O top exit will add approximately 95 lbs to each frame.
8. The side frame extenders for I/O top exit will add 305 mm (12 inches) to the width and 139.7 mm (5.5 in) to the height.
9. Weights for the water cooled option are dry weights. When filled, water will add 22.7 kg (50 lbs) to the total.
10. At inlet air temp 28° C (82.4° F) – water cooling for the M15 is 55% to 60%, water cooling for the M80 is 60% to 65%.
11. 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 System z family of IBM servers is among the most powerful group of mainframe processors ever built. Technology improvements have placed these servers 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 zEnterprise 196 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 z196 offers.

Environmental specifications are presented in two categories: Required and Recommended. Obviously, meeting the required specifications is prerequisite to using the zEnterprise 196. IBM strongly suggests you strive for more than the minimum requirements. The powerful computing z196 provides generates a great deal of heat. That heat must be removed from the equipment to keep it operating at peak efficiency. Cooling the servers can result in condensation on critical internal parts, leading to equipment failure, unless the computer room environment is adequately maintained to prevent it. That's where operating your data center with the goal of reaching recommended specifications instead of just the required numbers will pay off for you.

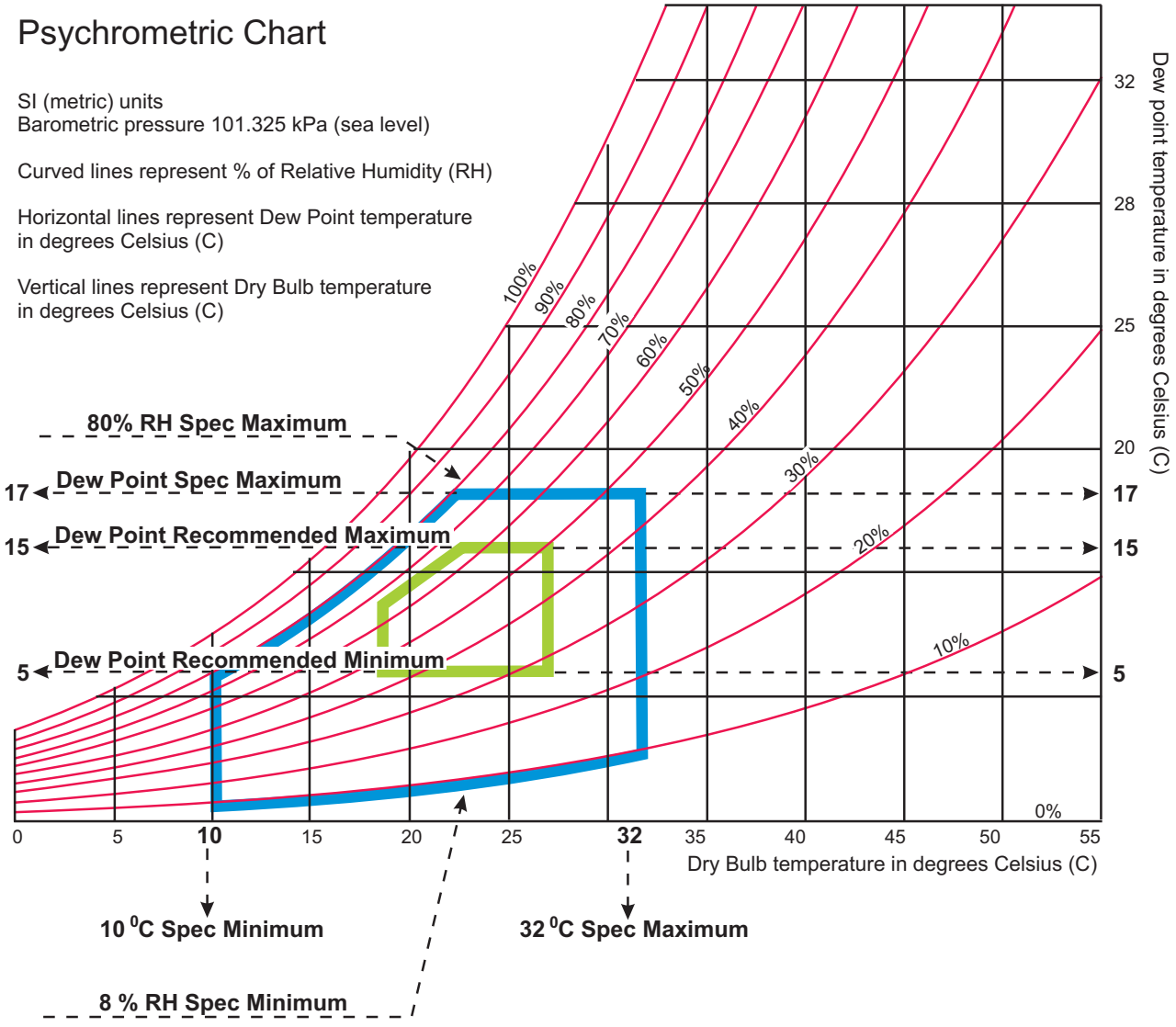
Unless otherwise noted on individual specification pages, the following environmental specifications, based on an altitude from sea level to 900 meters (2953 feet), apply:

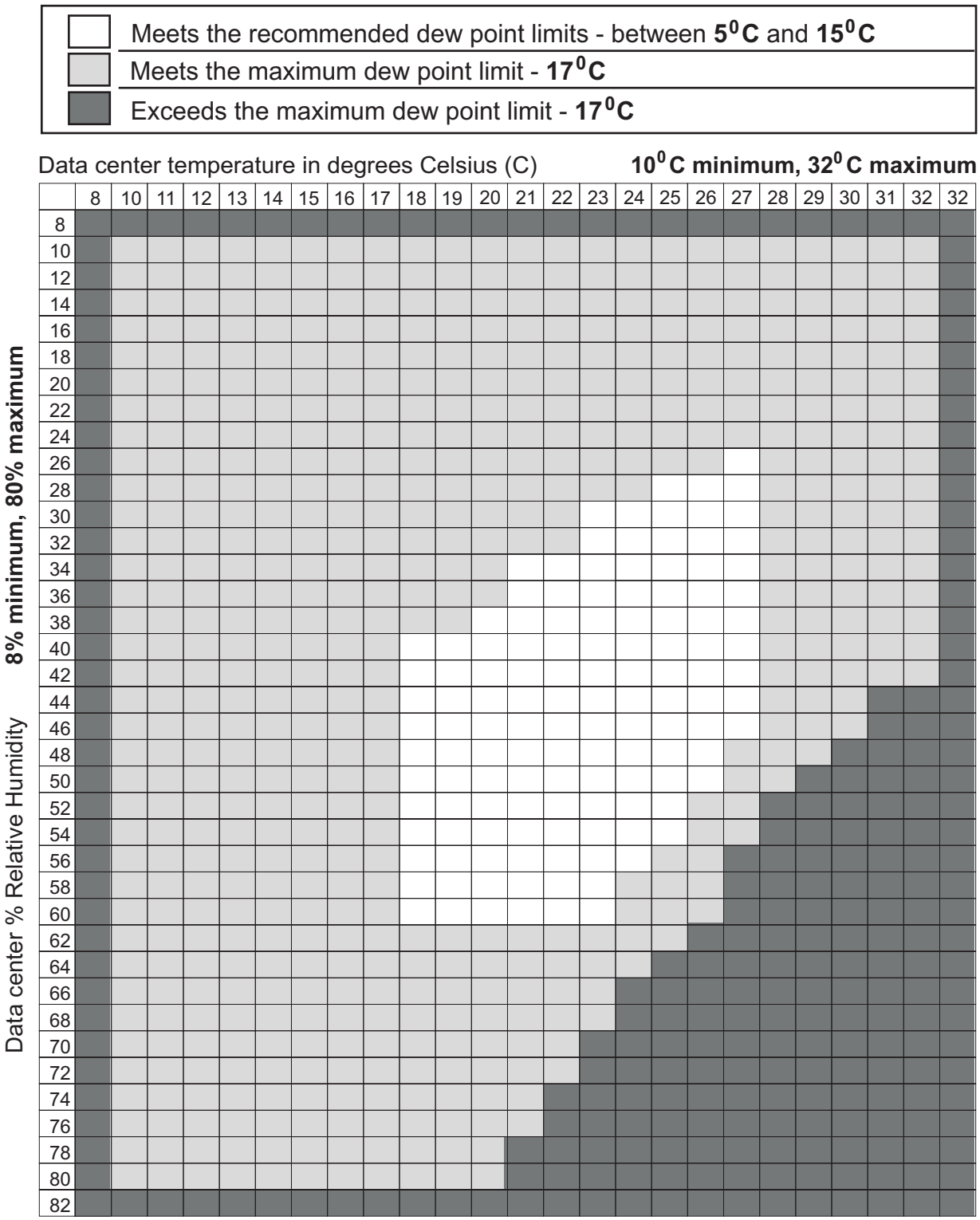
High Ambient Temperature	**Long-term recommended** 27°C (80.6°F)	**Maximum ambient allowed**32°C (89.6°F)
Low Ambient Temperature	**Long-term recommended**18° (64.4°F)	**Minimum ambient allowed**10° (50°F)
Low end humidity	**Long-term recommended**5.5°C (41.9°F) dew point	**Minimum relative humidity allowed**8%
High end humidity	**Long-term recommended**60% relative humidity and 15°C (59°F) dew point	**Maximum relative humidity allowed**80% relative humidity and 17°C (62.6°F) dew point
Class G1 as per ANSI/ISA S71.04–1985 [2]		

1. Room air must be filtered continuously using appropriate filters.
2. The deliquescent relative humidity of the particulate contamination shall be more than 80%

Non-operating Specifications
5°C (45°F) to 41°C (113°F)
8% - 80% R/H
Less than 27.3°C (80.6°F)
Class G1 as per ANSI/ISA S71.04–1985 [2]
Shipping Specifications
-40°C (-40°F) to 60°C (140°F)
5% - 100% R/H (no condensation)
Less than 29°C (84.2°F)
IBM-approved vapor barrier bag with desiccant
Storage Specifications
1°C (33.8°F) to 60°C (140°F)
5% -80% R/H (no condensation)
Less than 29°C (84.2°F)
IBM-approved vapor barrier bag with desiccant

The following illustrations reiterate the environmental specifications in graphic form.





It is very important the environmental specifications be met immediately in front of both frames of the zEnterprise 196 server. Ideally, it would be best if the temperature and humidity controls are good enough to surround the service area of the z196. If you are able to exceed the required conditions, focus your efforts to provide the best quality air at the bottom front of the server.

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 zEnterprise 196 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 z196 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 zEnterprise 196, IBM may condition provision of repair or replacement of zEnterprise 196 or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 2. 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 300 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.

Table 2. Contaminant Descriptions (continued)

Contaminant	Description
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 may be met simply 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:

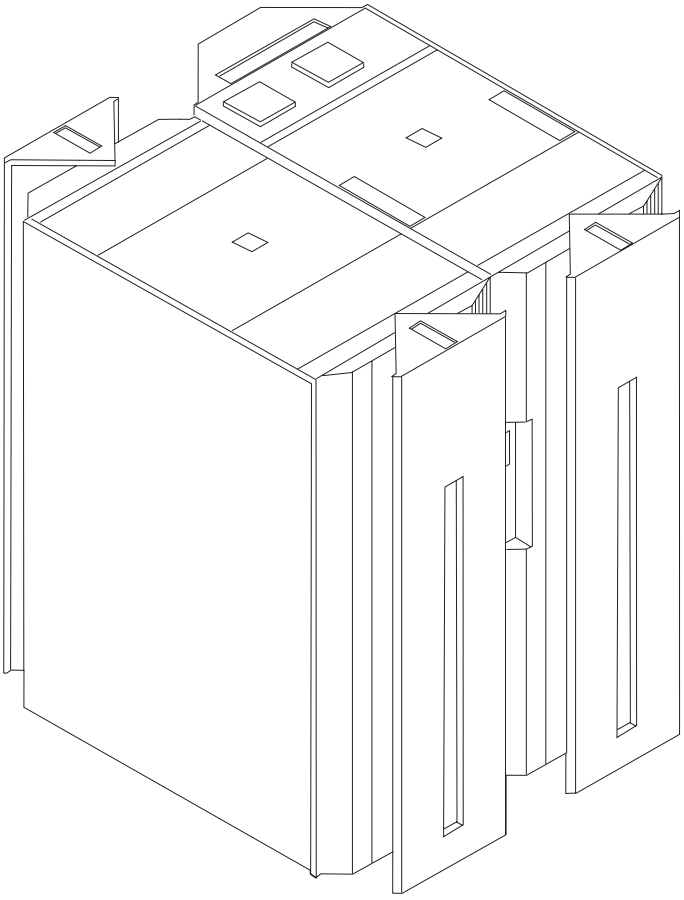
1. ANSI/ISA-71.04.1985. "Environmental conditions for process measurement and control systems: Airborne contaminants." Instrument Society of America, Research Triangle Park, NC, 1985.
2. The derivation of the equivalence between the rate of copper corrosion product thickness growth in Å/month and the 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, IBM recommends that the customer's facility meet the general guidelines published in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook*.

Chapter 3. Models and physical specifications

This chapter provides the following detailed information for the zEnterprise 196.

- Model and frame descriptions
- Shipping specifications
- Plan view and specifications
- Weight distribution data and service clearances information



Facts you should know about the zEnterprise 196:

- The zEnterprise 196 is **always** a two-frame system
- The zEnterprise 196 server 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 "Line Cord Plan-Ahead feature, FC 2000, which ships all four line cords regardless of the model.
- The server can be powered from either an AC or DC source.
- The 2817 can be cooled either by refrigerated air or customer-supplied chilled water. This document will refer to these cooling methods by the terms air-cooled, for refrigerated air, and water-cooled, for chilled water.
- The zEnterprise 196 server 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 frames are shipped as separate units, fastened together at install time.

Important:

The zEnterprise 196 server, fully configured, can weigh in excess of 2268 kg (5000 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 8008 and 8009 provide tie-down hardware for various height raised floors. See Appendix F, "Frame tie-down," on page 131 for more information.
- There are separate shipping containers for the covers for each frame
- Because of EMC (Electromagnetic Compatibility) requirements, and the potential for a large number of cables exiting both frames of the server, **installation on a raised floor is mandatory**. Refer to your national electric code if you have questions about routing data processing cables in exposed areas.
- **If you are planning an installation on a raised floor in Canada**, the installation must be in accordance with Section 12-020 of the CEC. In any country, refer to your national electric code if you have questions about routing data processing cables in exposed areas.

Physical dimensions

Notes:

1. In the following tables, air-cooled refers to a server that is cooled by refrigerated air and water-cooled refers to a server that is cooled by chilled water.
2. For all combinations, if the top exit I/O cabling towers (FC 7942) are installed, **each** frame is 153 mm (6 in) wider. See "Plan views" on page 32 for a visual reference.

A and Z frame/cover combination	Width mm (in)	Depth mm (in)	Height mm (in)
Frames w/covers - Air-cooled	1568 (61.7)	1806 (71.1)	2013 (79.3)
Frames w/covers - Air-cooled with I/O cable towers	1847 (72.7)	1806 (71.1)	2154 (84.8)
Frames w/covers - Water-cooled	1568 (61.7)	1908 (75.1)	2013 (79.3)
Frames w/covers - Water-cooled with I/O cable towers	1847 (72.7)	1908 (75.1)	2154 (84.8)

Shipping specifications

zEnterprise 196 servers are shipped two ways:

- Packaged systems are protected with an anti-static poly bag and heavy cardboard and roll on their own casters. This packaging is used only in the 48 contiguous United States.
- Crated systems are protected with wooden shipping boxes and are mounted on pallets requiring commercial lift transportation. This packaging is used for all servers shipped anywhere except the 48 contiguous United States.

Height reduction - FC 9975

If you have doorways with openings less than 2032 mm (80.0 in) high, you should order Feature Code 9975. This feature reduces the frame height to 1809 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 3212

If you ordered Feature Code 3212, the internal batteries are shipped in their own packaging. The batteries must always be installed along with the server.

Dimensions

Note: The weight does not include the weight of any internal batteries.

Packaged frames	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Packaged frame A (air-cooled)	825 (32.5)	1435 (56.5)	2032 (80.0)	1023 (2255)
Packaged frame A (water-cooled)	825 (32.5)	1600 (63.0)	2032 (80.0)	1080 (2380)
Packaged frame Z (air-cooled)	813 (32.0)	1397 (55.0)	2032 (80.0)	887 (1955)
Packaged frame Z (water-cooled)	813 (32.0)	1499 (59.0)	2032 (80.0)	944 (2080)
Packaged frame A (air-cooled) with height-reduced (FC 9975)	825 (32.5)	1435 (56.5)	1803 (71.0)	991 (2185)
Packaged frame A (water-cooled) with height-reduced (FC 9975)	825 (32.5)	1600 (63.0)	1803 (71.0)	1048 (2310)
Packaged frame Z (air-cooled) with height-reduced (FC 9975)	813 (32.0)	1397 (55.0)	1803 (71.0)	855 (1885)
Packaged frame Z (water-cooled) with height-reduced (FC 9975)	813 (32.0)	1499 (59.0)	1803 (71.0)	912 (2010)

Crated frames	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Crated frame A (air-cooled)	937 (36.9)	1618 (63.7)	2302 (90.6)	1341 (2955)
Crated frame A (water-cooled)	937 (36.9)	1727 (68.0)	2302 (90.6)	1398 (3080)
Crated frame Z (air-cooled)	937 (36.9)	1618 (63.7)	2302 (90.6)	1182 (2605)
Crated frame Z (water-cooled)	937 (36.9)	1727 (68.0)	2302 (90.6)	1239 (2732)

Cover set (front and read doors)	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Frame A	997 (39.3)	610 (24.0)	2248 (88.5)	70.3 (155)
Frame Z	997 (39.3)	610 (24.0)	2248 (88.5)	70.3 (155)

Top exit I/O towers (FC 7942)	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Frame A and Frame Z (two I/O towers per pack)	666.85 (26.3)	571.5 (22.5)	2133.6 (84.0)	86.2 (190.0)

Important:

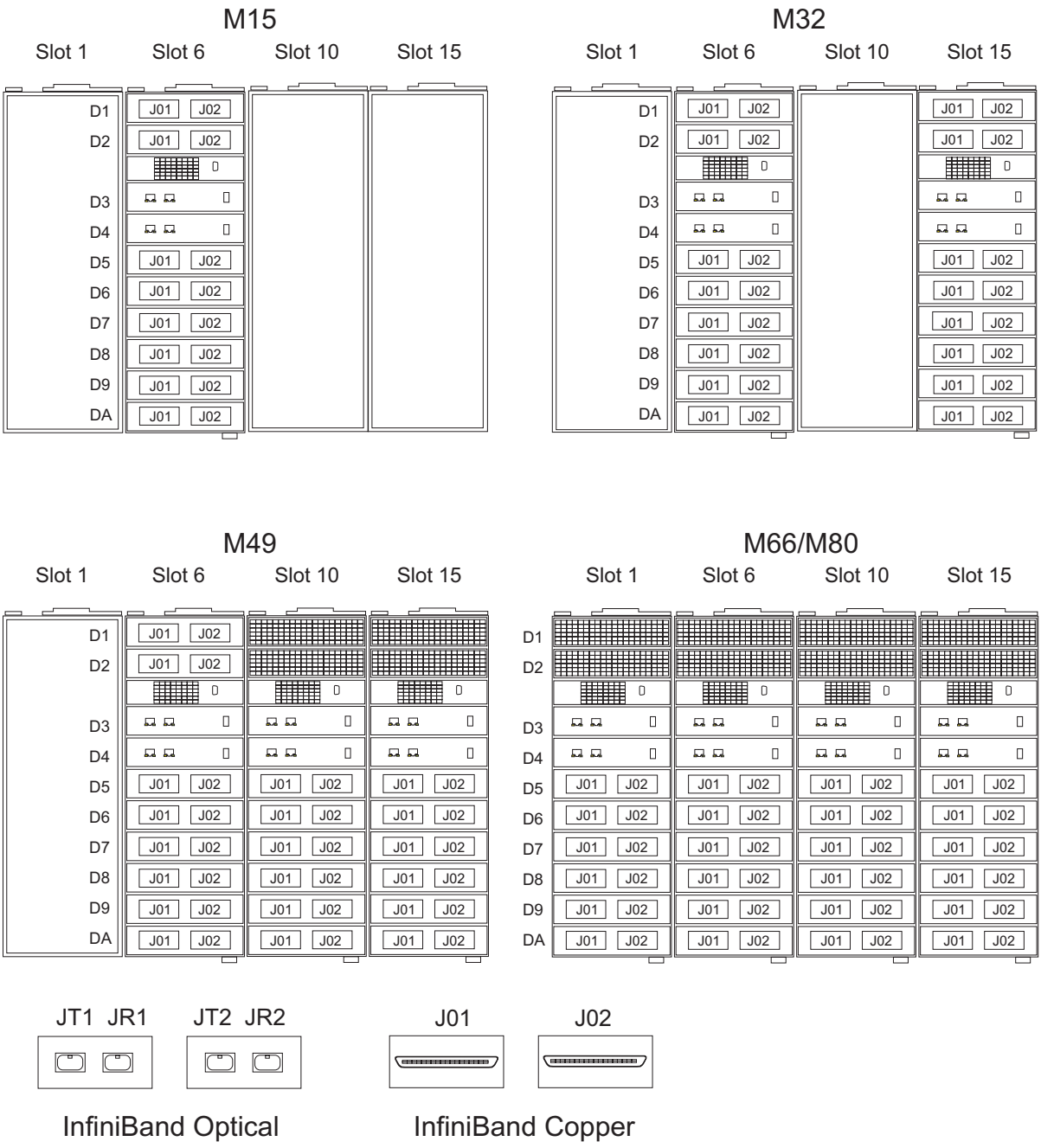
The zEnterprise 196 is comprised of some of the most sophisticated and complex electronic equipment ever integrated into one computer. As such, this hardware needs to be protected from negative environmental impacts to ensure the utmost reliability. One of the key factors affecting this reliability is 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.

zEnterprise 196 models

There are five models of the zEnterprise 196 server: M15, M32, M49, M66, and M80. 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 server models are shown in the following illustration with InfiniBand® copper and InfiniBand optical ports installed. The actual number of ports for any model is dependent on total system configuration as ordered. Model specifications are described in the Feature Code table on the next page.

Note: InfiniBand copper cables are used only to connect the I/O cages to the processor.



Note: In the following tables, air-cooled refers to a server that is cooled by refrigerated air. Water-cooled refers to a server that is cooled by chilled water.

Table 3. Model feature codes and options

Feature code	Description - number of processor books	I/O connectors
FC 1125 (Air-cooled) FC 1130 (Water-cooled) Model M15	• 1 Book • 0 - 15 CPs or IFLs/uIFLs • 0 - 15 ICFs • 0 - 7 zAAPs • 0 - 7 zIIPs • 3 - Base SAPs, 0 - 4 Optional SAPs, • 2 - spares	16 total connector positions available • 0 - 16 InfiniBand Optical
FC 1126 (Air-cooled) FC1131 (Water-cooled) Model M32	• 2 Books • 0 - 32 CPs or IFLs/uIFLs • 0 - 16 ICFs • 0 - 16 zAAPs • 0 - 16 zIIPs • 6- Base SAPs, 0 - 10 Optional SAPs, • 2 - spares	32 total connector positions available • 0 - 32 InfiniBand Optical
FC 1127 (Air-cooled) FC1132 (Water-cooled) Model M49	• 3 Books • 0 - 49 CPs or IFLs/uIFLs • 0 - 16 ICFs • 0 - 24 zAAPs • 0 - 24 zIIPs • 9 - Base SAPs, 0 - 15 Optional SAPs, • 2 - spares • Up to 1024 CHPIDs	40 total connector positions available • 0 - 32 InfiniBand Optical
FC 1128 (Air-cooled) FC1133 (Water-cooled) Model M66	• 4 Books • 0 - 66 CPs or IFLs/uIFLs • 0 - 16 ICFs • 0 - 33 zAAPs • 0 - 33 zIIPs • 12 - Base SAPs, 0 - 20 Optional SAPs, • 2 - spares	48 total connector positions available • 0 - 32 InfiniBand Optical
FC 1129(Air-cooled) FC1134 (Water-cooled) Model M80	• 4 Books • 0 - 80 CPs or IFLs/uIFLs • 0 - 16 ICFs • 0 - 40 zAAPs • 0 - 40 zIIPs • 14 - Base SAPs, 0 - 18 Optional SAPs, • 2 - spares	48 total connector positions available • 0 - 32 InfiniBand Optical
FC 3212	• Internal Battery Feature • Available in all models • Up to three pairs of batteries are provided, depending on system power configuration.	
Notes: 1. CP - Central Processor 2. IFL - Integrated Facility for Linux 3. ICF - Integrated Coupling Facility 4. SAP - System Assist Processor 5. zAAP - IBM System zEnterprise 196 Application Assist Processor 6. zIIP - IBM System zEnterprise 196 Integrated Information Processor		

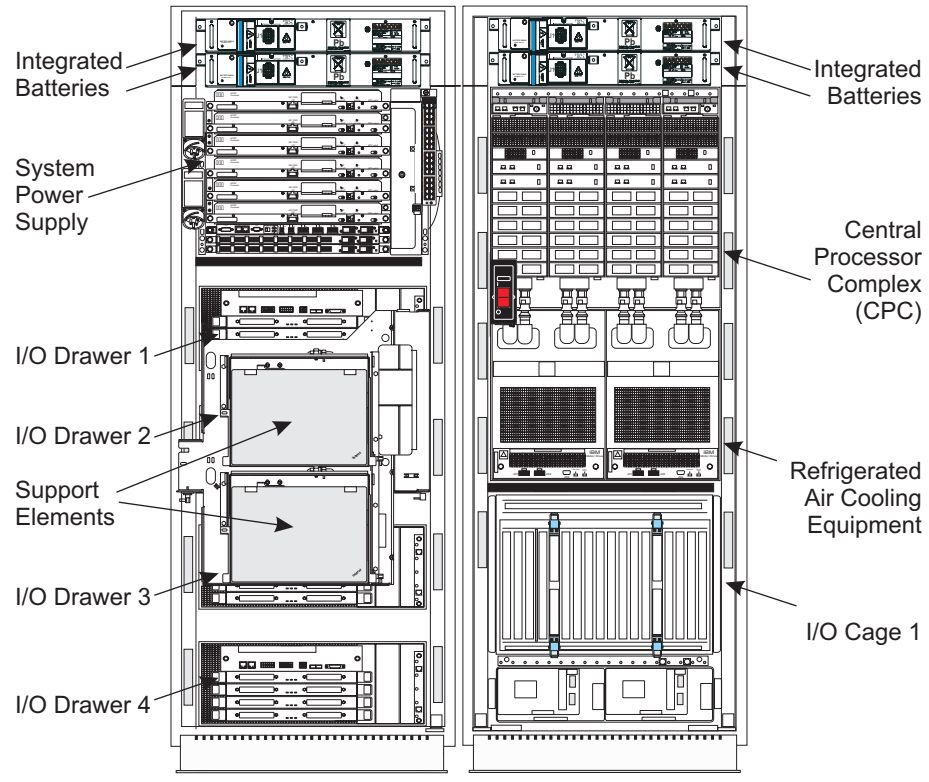
Additionally, as shown below:

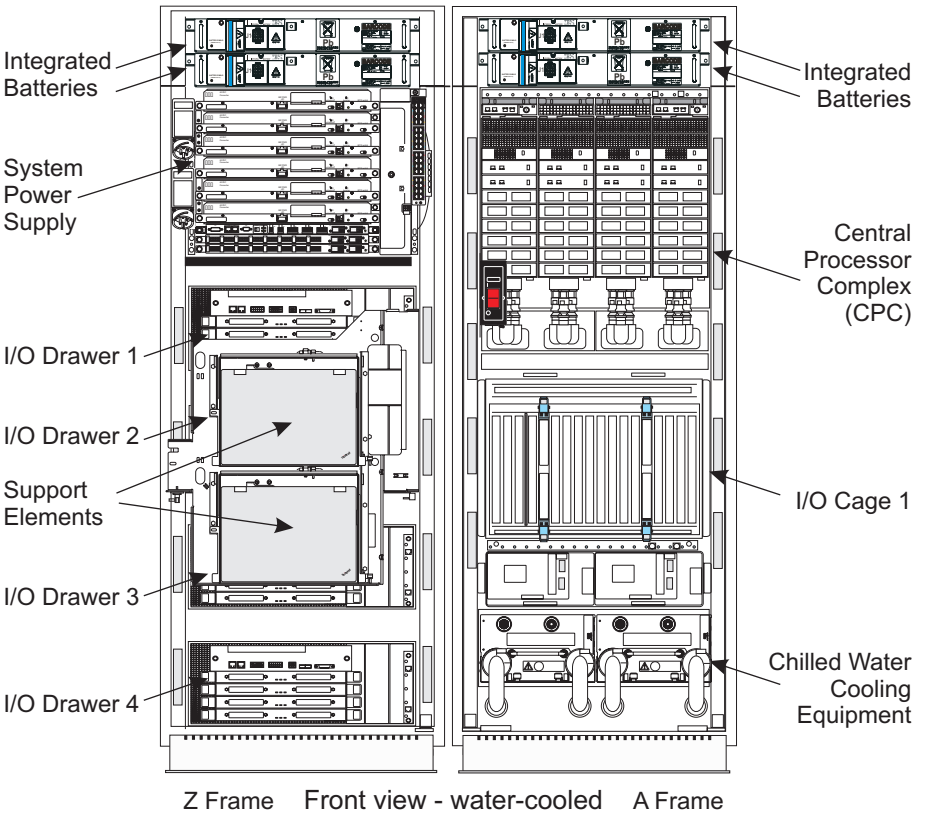
- Internal batteries (for emergency backup power) are placed in the topmost positions in both frames. (In the front ONLY on the A frame)
- The system processor is located in the Central Electronics Complex (CEC) cage, below the battery position in the A frame
- Processor cooling components are located below the processor in the front of the A frame, and from the top of the frame to the top of the I/O cage in the rear 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 Input/Output (I/O) cages and drawers. These I/O cages and drawers are installed in the empty space at the bottom of the A frame and the area below the bulk power supply in the Z frame.

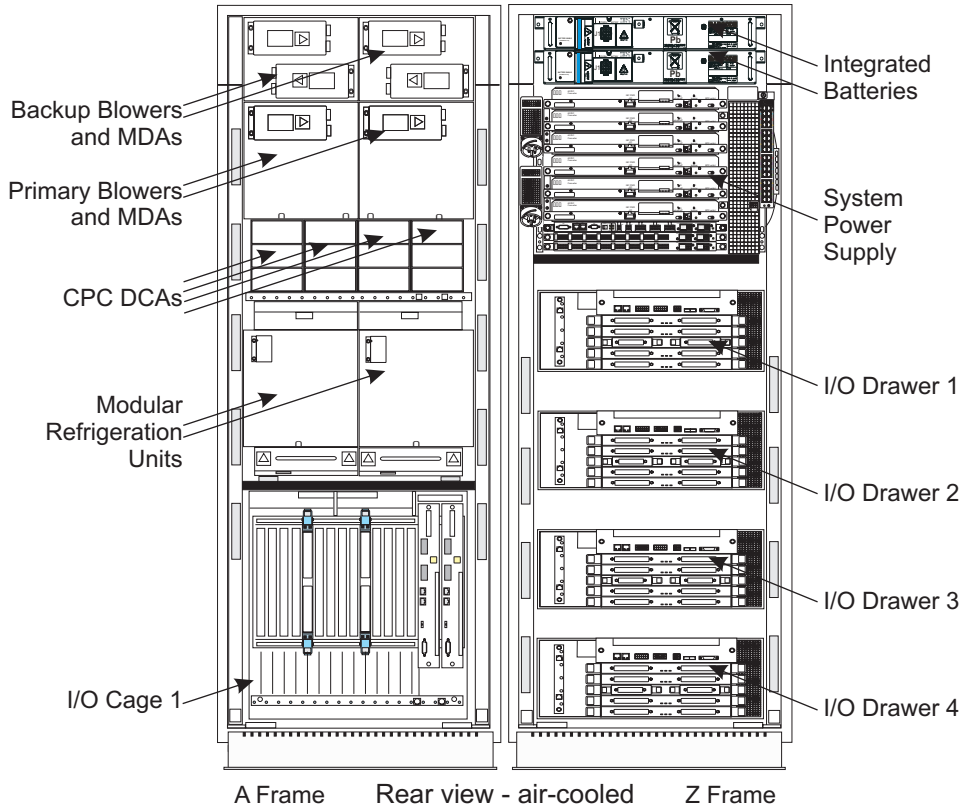
You will use the feature codes shown in the following table to place your zEnterprise 196 order.

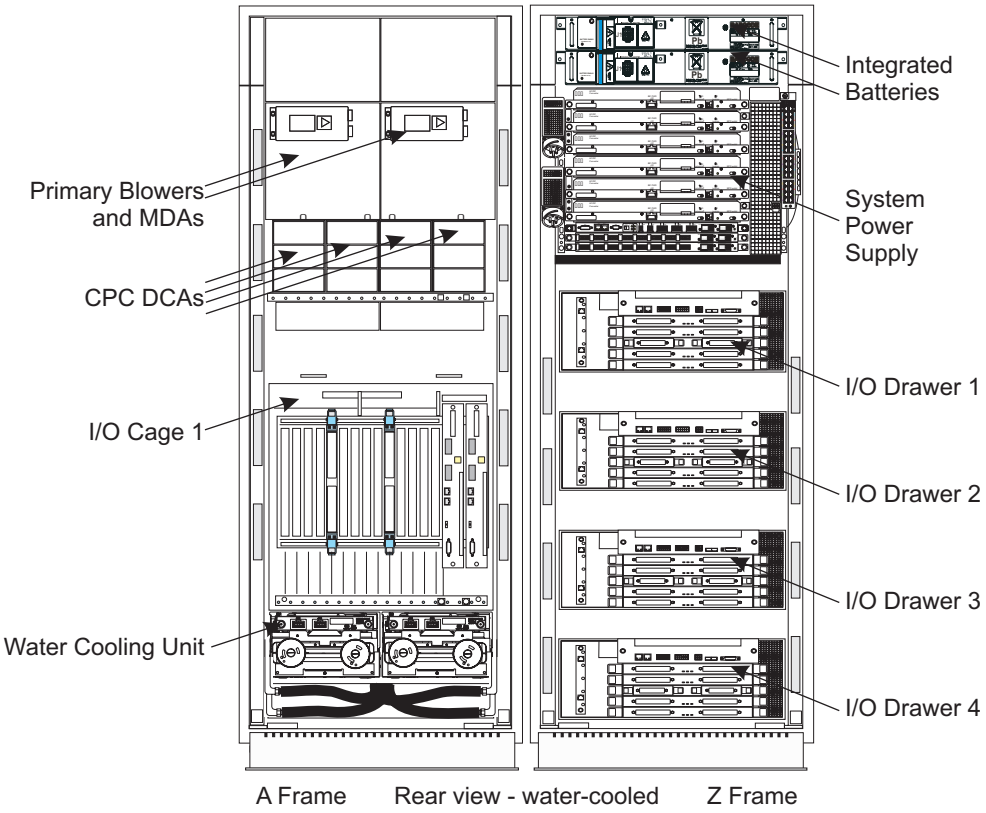
Table 4. Processor descriptions

Feature Code	Description
1125	Model M15, Air-cooled, 1 processor book
1126	Model M32, Air-cooled, 2 processor books
1127	Model M49, Air-cooled, 3 processor books
1128	Model M66, Air-cooled, 4 processor books
1129	Model M80, Air-cooled, 4 processor books
1130	Model M15, Water-cooled, 1 processor book
1131	Model M32, Water-cooled, 2 processor books
1132	Model M49, Water-cooled, 3 processor books
1133	Model M66, Water-cooled, 4 processor books
1134	Model M80, Water-cooled, 4 processor books


Integrated Batteries
System Power Supply
I/O Drawer 1
I/O Drawer 2
Support Elements
I/O Drawer 3
I/O Drawer 4
Integrated Batteries
Central Processor Complex (CPC)
Refrigerated Air Cooling Equipment
I/O Cage 1
Z Frame
Front view - air-cooled
A Frame


Integrated Batteries
System Power Supply
I/O Drawer 1
I/O Drawer 2
Support Elements
I/O Drawer 3
I/O Drawer 4
Integrated Batteries
Central Processor Complex (CPC)
I/O Cage 1
Chilled Water Cooling Equipment
Z Frame
Front view - water-cooled
A Frame

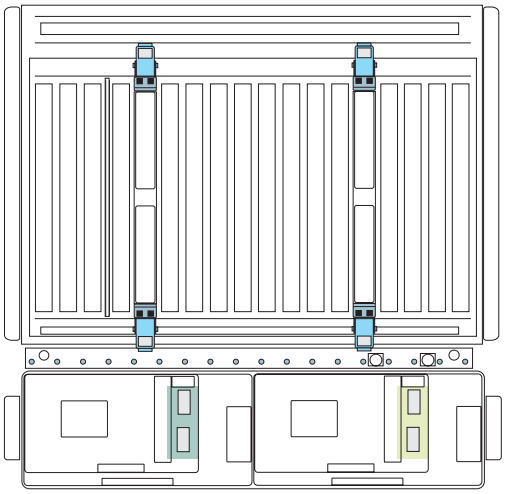

Backup Blowers and MDAs
Primary Blowers and MDAs
CPC DCAs
Modular Refrigeration Units
I/O Cage 1
Integrated Batteries
System Power Supply
I/O Drawer 1
I/O Drawer 2
I/O Drawer 3
I/O Drawer 4
A Frame
Rear view - air-cooled
Z Frame


Primary Blowers and MDAs
CPC DCAs
I/O Cage 1
Water Cooling Unit
Integrated Batteries
System Power Supply
I/O Drawer 1
I/O Drawer 2
I/O Drawer 3
I/O Drawer 4
A Frame
Rear view - water-cooled
Z Frame

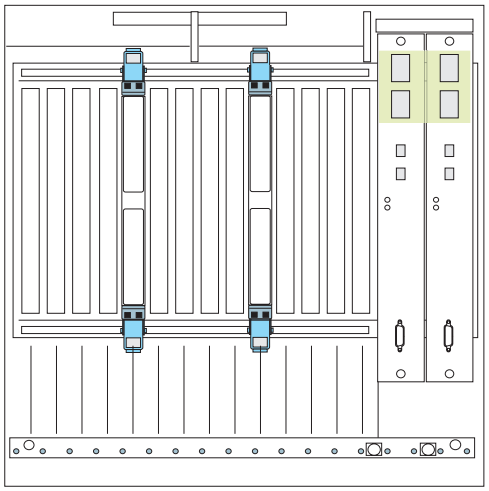
I/O cages and drawers

The z196 server provides I/O adapters in three different packages.

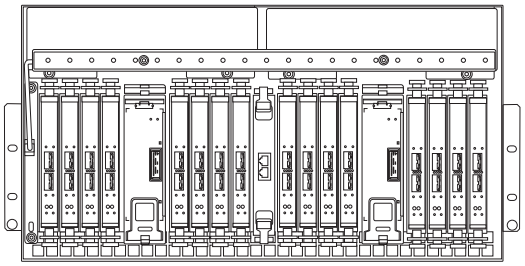
- I/O cage - legacy packaging for I/O -14 EIA units tall - provides 28 adapters, with up to four ports per adapter.
- I/O drawer - small size - 5 EIA units tall - provides 8 adapters, with up to four ports per adapter.
- PCIe I/O drawer - new size and new I/O adapters - 7 EIA units tall - provides 32 adapters, with two ports per adapter.



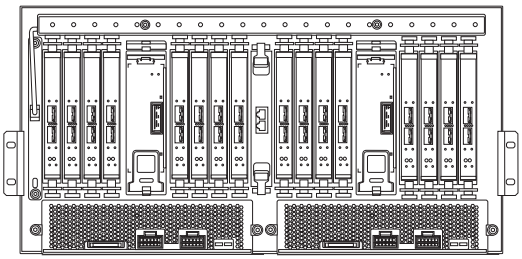
I/O cage front view



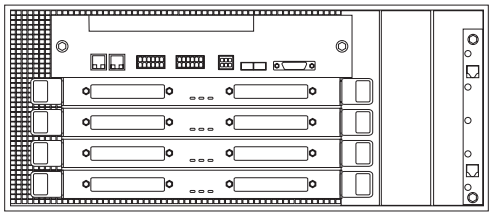
I/O cage rear view



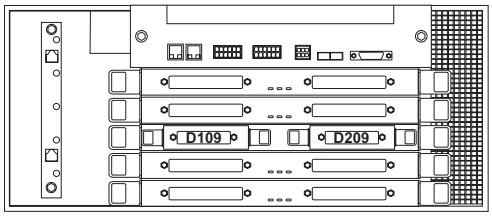
PCIe I/O drawer front view



PCIe I/O drawer rear view



I/O drawer front view



I/O drawer rear view

System upgrades

Any model of 2097 (System z10™ EC) or 2094 (System z9® EC) is upgradeable to any model of zEnterprise 196.

Differences between IBM servers

Although you cannot upgrade to a zEnterprise 196 from any previous IBM server except the z10 EC or z9 EC, minimum comparison information is provided here for those who may be placing a z196 on a raised floor with G5/G6, z900, z990, z9 EC, or z10 EC 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 lbs)
z900 (2064)	1666 mm (65.6 in)	2026 mm (79.8 in)	1866 kg (4114 lbs)
z990 (2084)	1577 mm (62.1 in)	1941 mm (76.4 in)	2008 kg (4427 lbs)
z9 EC (2094)	1577 mm (62.1 in)	1941 mm (76.4 in)	2003 kg (4415 lbs)
z10 EC (2097)	1806 mm (71.1 in)	2027 mm (79.8 in)	2318 kg (5110 lbs)
zEnterprise 196 (2817) (Air-cooled)	1806 mm (71.1 in)	2027 mm (79.8 in)	2399 kg (5289 lbs)
zEnterprise 196 (2817) (Water-cooled)	1806 mm (75.1 in)	2027 mm (79.8 in)	2407 kg (5307 lbs)

Notes:

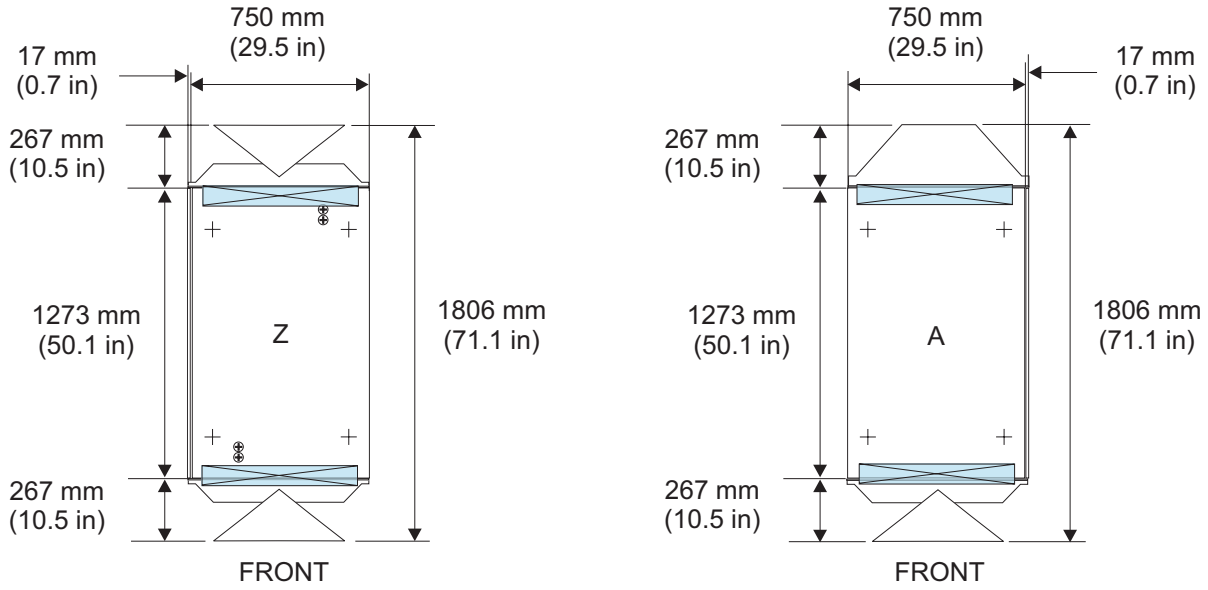
1. All server frames are the same width, approximately 775 mm (30.5 in) with the side covers installed.
2. The zEnterprise 196 frames, with the optional I/O cabling top exit feature (FC 7942), are 927 mm (36.5 in) wide.
3. The zEnterprise 196, z10 EC, z9 EC, and z990 servers always consist of two frames. 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.
4. Major differences in power and processor packaging, cooling, and I/O cages exist between z196, z10 EC, z9 EC, z990, z900, and 9672 G5/G6 servers.

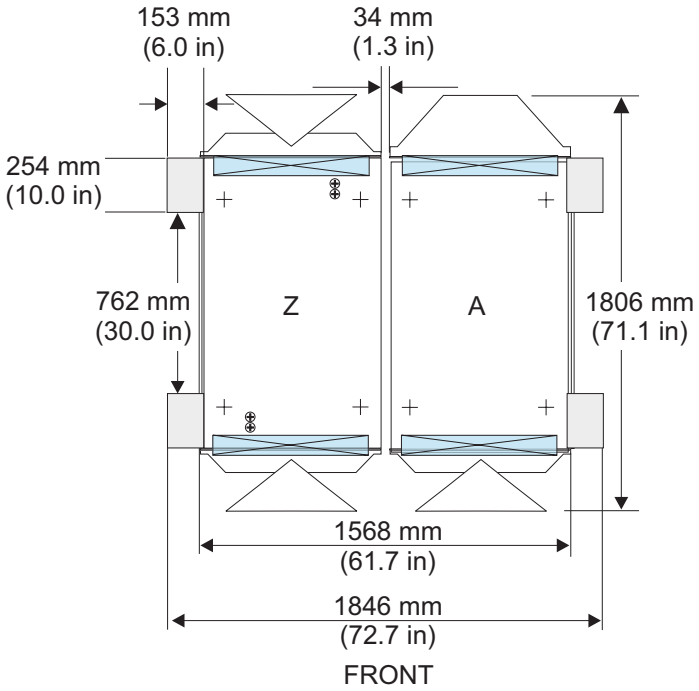
If you are replacing an existing IBM server, refer carefully to the *zEnterprise 196 Installation Manual for Physical Planning* (available on the Resource Link) to determine actual differences between your installed IBM server and the zEnterprise 196. Plan views, physical dimensions, service clearances, 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.

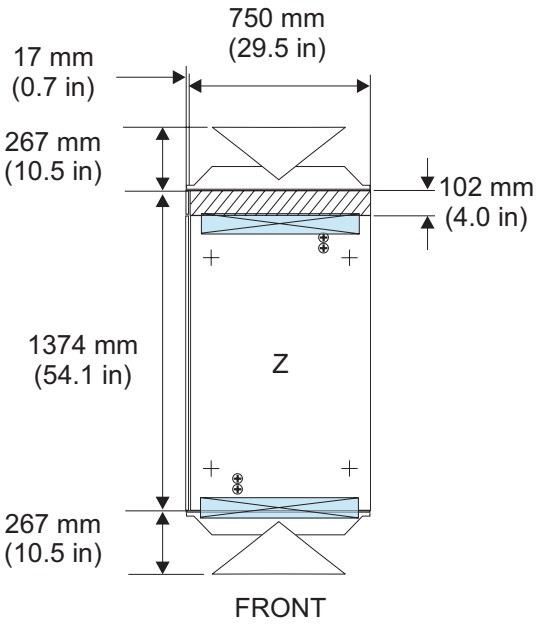
Refrigerated air cooling

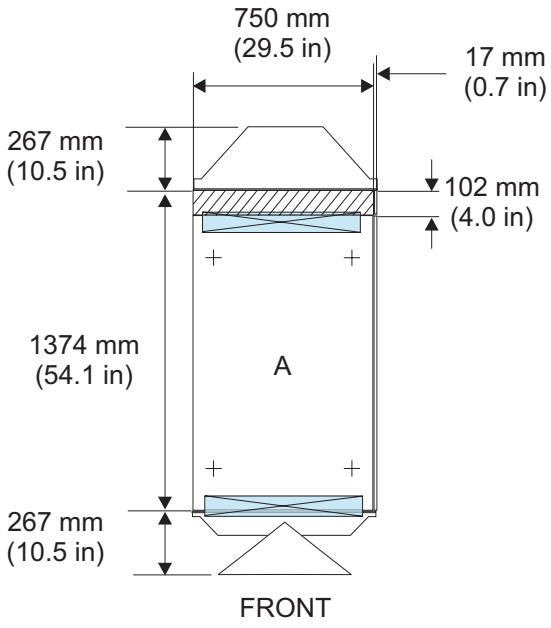


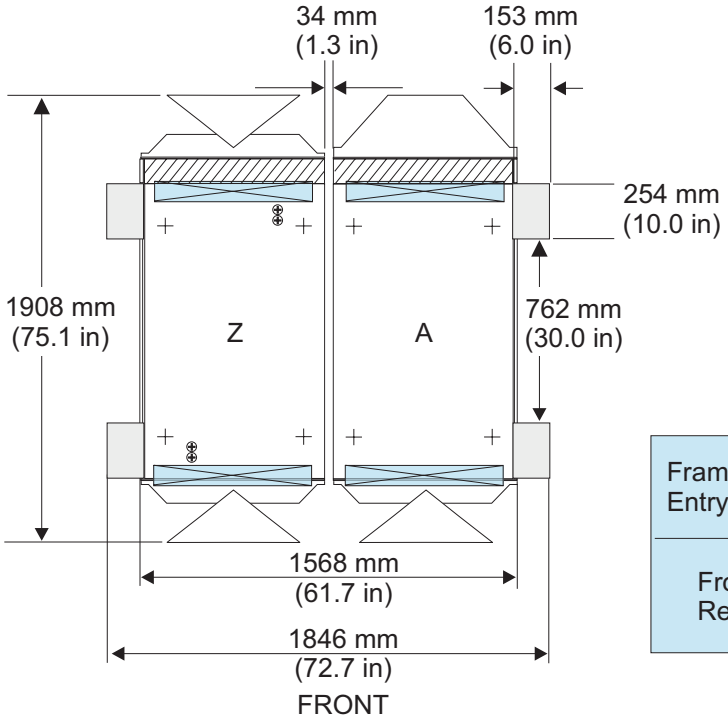


Frame Entry/Exit	Dimension	
	(mm)	(in)
Front Rear	94 x 655 94 x 655	3.7 x 25.8 3.7 x 25.8

Chilled water cooling







Frame Entry/Exit	Dimension	
	(mm)	(in)
Front Rear	94 x 655 94 x 655	3.7 x 25.8 3.7 x 25.8

Weight distribution

The following table shows weights and dimensions used to calculate floor loading for the zEnterprise 196. All floor loading calculations are intended for a raised floor environment.

Table 5. Maximum weights with Internal Battery Feature (IBF)

Maximum	A and Z frames with Internal Battery Feature code (3212) - Model M80
Air-cooled	
Weight kg (lbs) [1,2,4]	2177 (5099)
Width mm (in) [3]	1534 (60.7)
Depth mm (in)	1273 (50.1)
Water-cooled	
Weight kg (lbs) [1,2,4]	2185 (5117)
Width mm (in) [3]	1534 (60.7)
Depth mm (in)	1374 (54.1)

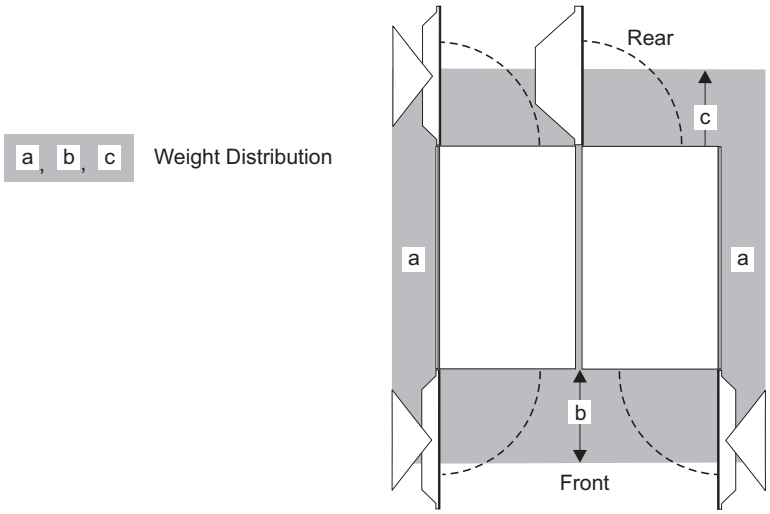
Table 6. Maximum weights without the Internal Battery Feature (IBF)

Maximum	A and Z frames without Internal Battery Feature code (3212) - Model M80
Air-cooled	
Weight kg (lbs) [1,2,4]	1894 (4475)
Width mm (in) [3]	1534 (60.7)
Depth mm (in)	1273 (50.1)
Water-cooled	
Weight kg (lbs) [1,2,4]	1902 (4493)
Width mm (in) [3]	1534 (60.7)
Depth mm (in)	1374 (54.1)

Notes:

1. Weight includes covers. Width and depth are indicated without covers.
2. For two-frame systems, weight is based on maximum system configuration, not the addition of the maximum weight of each frame.
3. Width increases to 1846 mm (72.7 in) if the top exit for I/O cables feature (FC 7942) is installed.
4. Weight increases by 86.2.1 kg (190 lbs) if the I/O top exit feature is installed.

The following figure and tables show sample floor loading values for the zEnterprise 196 server, with and without the Internal Battery Feature (3212), and **without** the top exit I/O feature (7942).



Floor loading for air-cooled servers **without** Internal Battery Feature:

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)	749.5 (153.3)
2	25 (1.0)	508 (20.0)	508 (20.0)	616.8 (126.1)
3	25 (1.0)	762 (30.0)	762 (30.0)	530.6 (108.5)
4	254 (10.0)	254 (10.0)	254 (10.0)	610.0 (124.7)
5	254 (10.0)	508 (20.0)	508 (20.0)	506.9 (103.7)
6	254 (10.0)	762 (30.0)	762 (30.0)	440.0 (90.0)
7	508 (20.0)	254 (10.0)	254 (10.0)	513.7 (105.0)
8	508 (20.0)	508 (20.0)	508 (20.0)	431.1 (88.1)
9	508 (20.0)	762 (30.0)	762 (30.0)	377.4 (77.2)
10	762 (30.0)	254 (10.0)	254 (10.0)	449.3 (91.9)
11	762 (30.0)	508 (20.0)	508 (20.0)	380.3 (77.8)
12	762 (30.0)	762 (30.0)	762 (30.0)	335.6 (68.6)

Floor loading for air-cooled servers **with** Internal Battery Feature:

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)	844.0 (172.6)
2	25 (1.0)	508 (20.0)	508 (20.0)	691.1 (141.3)
3	25 (1.0)	762 (30.0)	762 (30.0)	591.9 (121.0)
4	254 (10.0)	254 (10.0)	254 (10.0)	683.3 (139.7)
5	254 (10.0)	508 (20.0)	508 (20.0)	564.7 (115.5)
6	254 (10.0)	762 (30.0)	762 (30.0)	487.6 (99.7)
7	508 (20.0)	254 (10.0)	254 (10.0)	572.5 (117.1)
8	508 (20.0)	508 (20.0)	508 (20.0)	477.3 (97.6)
9	508 (20.0)	762 (30.0)	762 (30.0)	415.6 (85.0)
10	762 (30.0)	254 (10.0)	254 (10.0)	498.3 (101.9)
11	762 (30.0)	508 (20.0)	508 (20.0)	419.0 (85.7)
12	762 (30.0)	762 (30.0)	762 (30.0)	367.4 (75.1)

Floor loading for water-cooled servers **without** Internal Battery Feature:

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)	752.2 (153.8)
2	25 (1.0)	508 (20.0)	508 (20.0)	618.9 (126.6)
3	25 (1.0)	762 (30.0)	762 (30.0)	523.3 (108.8)
4	254 (10.0)	254 (10.0)	254 (10.0)	612.1 (125.2)
5	254 (10.0)	508 (20.0)	508 (20.0)	508.5 (104.0)
6	254 (10.0)	762 (30.0)	762 (30.0)	441.3 (90.2)
7	508 (20.0)	254 (10.0)	254 (10.0)	515.3 (105.4)
8	508 (20.0)	508 (20.0)	508 (20.0)	432.4 (88.4)
9	508 (20.0)	762 (30.0)	762 (30.0)	378.5 (77.4)
10	762 (30.0)	254 (10.0)	254 (10.0)	450.7 (92.2)
11	762 (30.0)	508 (20.0)	508 (20.0)	381.4 (78.0)
12	762 (30.0)	762 (30.0)	762 (30.0)	336.5 (68.8)

Floor loading for water-cooled servers **with** Internal Battery Feature

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)	846.6 (173.1)
2	25 (1.0)	508 (20.0)	508 (20.0)	693.2 (141.8)
3	25 (1.0)	762 (30.0)	762 (30.0)	593.6 (121.4)
4	254 (10.0)	254 (10.0)	254 (10.0)	685.4 (140.2)
5	254 (10.0)	508 (20.0)	508 (20.0)	566.3 (115.8)
6	254 (10.0)	762 (30.0)	762 (30.0)	488.9 (100.0)
7	508 (20.0)	254 (10.0)	254 (10.0)	574.1 (117.4)
8	508 (20.0)	508 (20.0)	508 (20.0)	478.7 (97.9)
9	508 (20.0)	762 (30.0)	762 (30.0)	416.7 (85.2)
10	762 (30.0)	254 (10.0)	254 (10.0)	499.7 (102.2)
11	762 (30.0)	508 (20.0)	508 (20.0)	420.1 (85.9)
12	762 (30.0)	762 (30.0)	762 (30.0)	368.3 (75.3)

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 1 on page 40.

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

System weight examples

Following is a table that provides weight estimates for minimum, typical, and maximum configurations on all five models of the z196. 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 69.

Table 7. Weights for minimum, typical, and maximum server configurations

Weight (in lbs) for an air-cooled server				Additional weights for features			
Model	**Minimum weight**	**Typical weight**	**Maximum weight**	**Water weight**	**Top Exit I/O weight**	**Battery weight**	**Balanced power**
M15	2362	3000	3986	258	190	450	225
M32	2745	3400	4426	60	190	670	170
M49	2950	3600	4739	60	190	670	110
M66 / M80	3155	4300	4868	60	190	670	55

Notes:

1. Minimum weights include no listed features and no I/O
2. Maximum weight includes 5 x Feature Code 4003 and 1 x Feature Code 4000 and no listed features. All slots in the I/O drawers (4003 and 4000) contain an adapter.
3. Typical weights contain I/O considered typical in a balanced system for the respective model. Actual weight will vary and can only be determined by an exact specification of content.

Example: a typical air-cooled M32 with batteries and balanced power = 3400 + 670 + 170 = 4240 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 **991 mm (39 in.)**.
- Front dimension “e” is **1168 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: Note that aisle clearances are not the same between rows of front-facing and rear-facing covers. Front-facing rows require **1168 mm (46 in.)** of clearance while rear-facing rows need a **minimum** of **991 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.

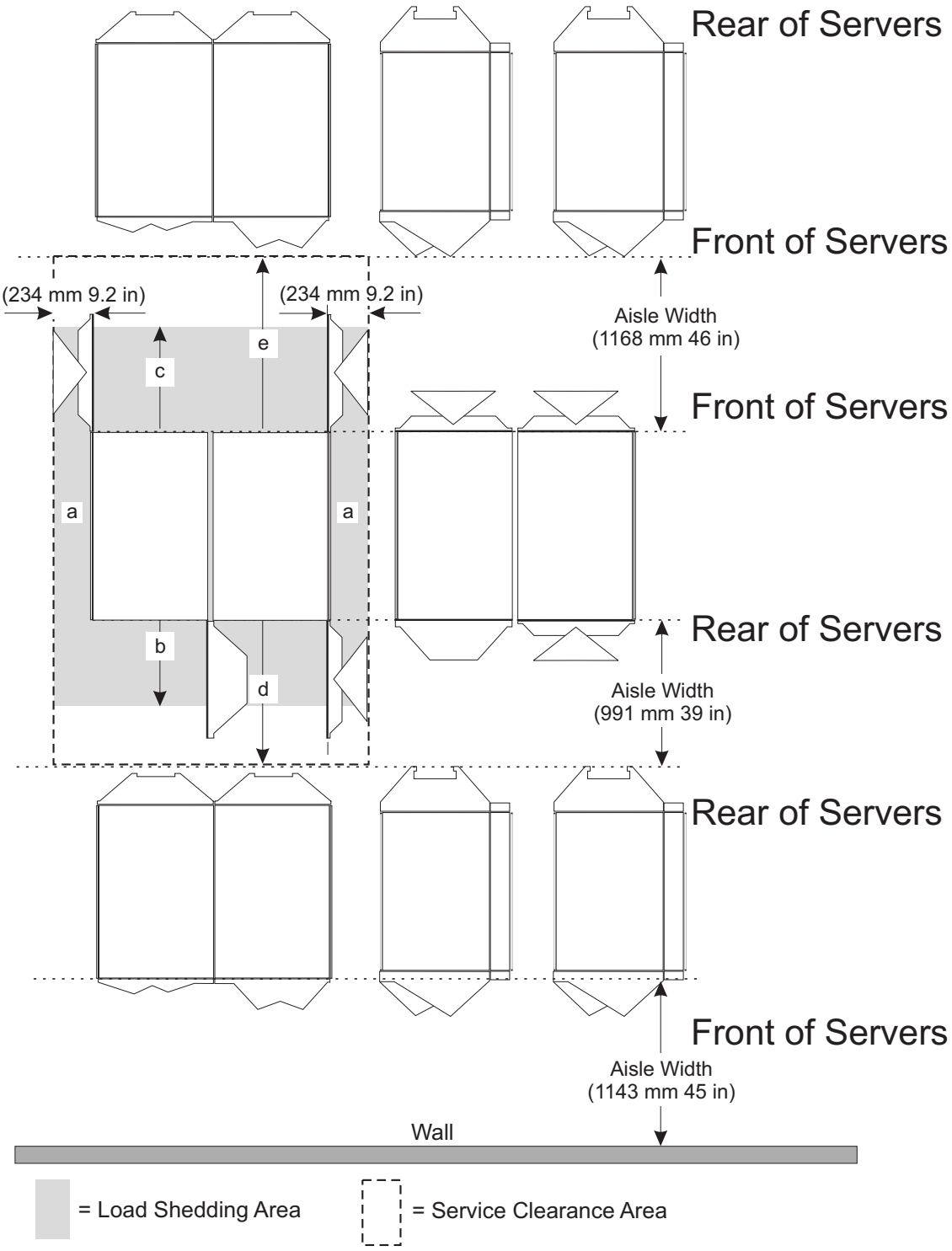


Figure 1. Aisle and service clearances

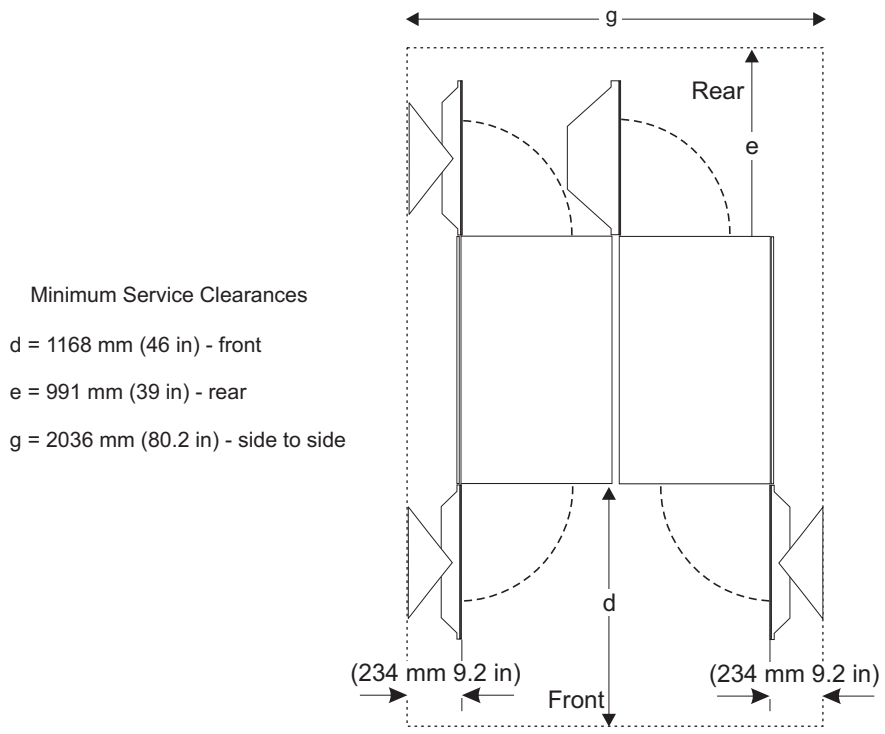
Machine and service clearance areas

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)
Air-cooled	1.95 / (21.0)	6.87 / (74.0)
Air-cooled plus I/O top exit	2.34 / (25.2)	6.87 / (74.0)
Water-cooled	2.10 / (22.6)	7.07 / (76.2)
Water-cooled plus I/O top exit	2.53 / (27.1)	7.07 / (76.2)

Notes:

1. Machine area includes installed covers.
2. 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.
3. The I/O top exit towers, FC 7942, are **optional**. Service clearance is **not shown** for these towers.
4. **Front-to-front aisle spacing of at least 1168 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.**



The front and rear doors access all of the serviceable area in the zEnterprise 196 server. 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 2 on page 42.)

- The side cover of either an 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 cover on frame A and both covers on frame Z open 234 mm (9.2 in) wider than the width of the frame plus side cover (Example **C**).
- Service clearances **cannot** be achieved with a zEnterprise 196 server installed side-cover-to-side-cover. Dimensions are given for z196 next to z196. To calculate side-to-side clearance, add 234 mm (9.2 in) to the clearance required from the adjacent equipment (Example **D**).

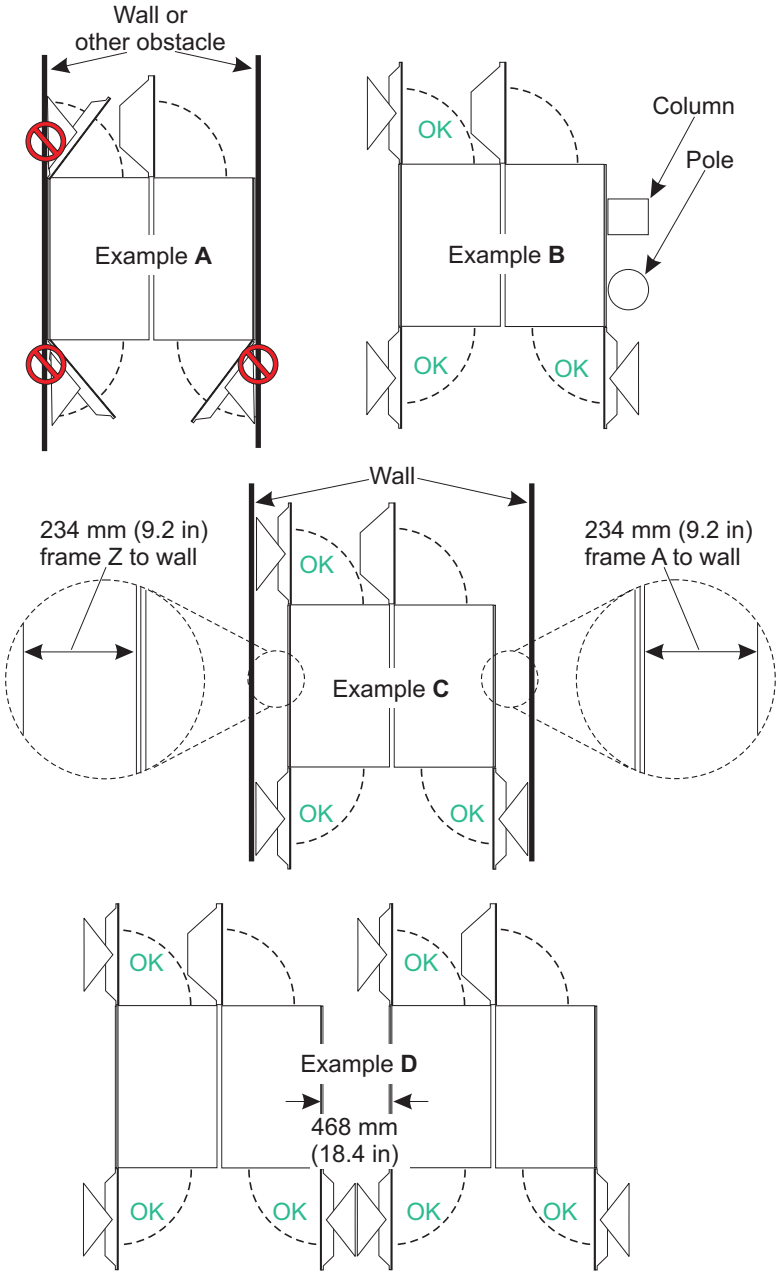


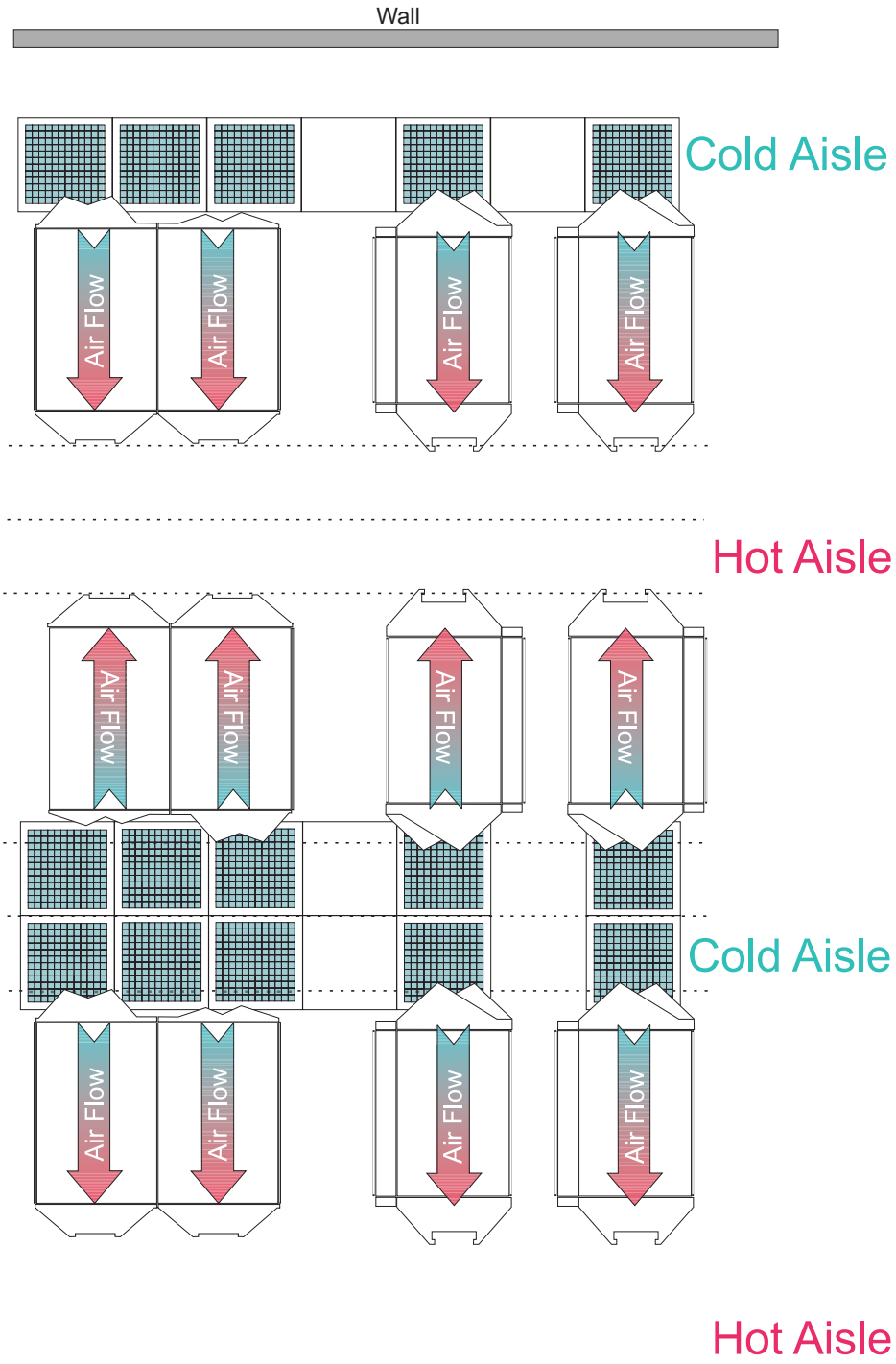
Figure 2. Detailed service clearances

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 zEnterprise 196 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.

Level 02f


Wall
Cold Aisle
Air Flow
Air Flow
Air Flow
Air Flow
Hot Aisle
Air Flow
Air Flow
Air Flow
Air Flow
Cold Aisle
Air Flow
Air Flow
Air Flow
Air Flow
Hot Aisle

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 z196.

Table 8. Cooling airflow graph codes - M15

Model	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)	Use cooling curve
M15 typical	Air-cooled	5.5	-	5.5	B
M15 maximum	Air-cooled	11	-	11	D
M15 typical	Water-cooled	5.1	4.1	1.0	A
M15 maximum	Water-cooled	10.7	8.0	2.7	A

Table 9. Cooling airflow graph codes - M32

Model	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)	Use cooling curve
M32 typical	Air-cooled	10	-	10	D
M32 maximum	Air-cooled	16.4	-	16.4	G
M32 typical	Water-cooled	9.0	7.4	1.6	A
M32 maximum	Water-cooled	15.3	11.5	3.8	A

Table 10. Cooling airflow graph codes - M49

Model	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)	Use cooling curve
M49 typical	Air-cooled	14	-	14	F
M49 maximum	Air-cooled	20	-	20	H
M49 typical	Water-cooled	12.2	10.3	2.5	A
M49 maximum	Water-cooled	18	13	5	B

Table 11. Cooling airflow graph codes - M66

Model	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)	Use cooling curve
M66 typical	Air-cooled	18.2	-	18.2	H
M66 maximum	Air-cooled	23.3	-	23.3	J
M66 typical	Water-cooled	15.3	11.7	3.6	B
M66 maximum	Water-cooled	20.4	14.3	6.1	C

Table 12. Cooling airflow graph codes - M80

Model	Cooling method	Total power (in kw)	Power to water (in kw)	Power to air (in kw)	Use cooling curve
M80 typical	Air-cooled	19.2	-	19.2	H
M80 maximum	Air-cooled	24.3	-	24.3	J
M80 typical	Water-cooled	16.3	12.5	3.8	B
M80 maximum	Water-cooled	21.4	15	6.4	C

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

- Room inlet air = 24ºC
- Customer water inlet = 17ºC
- Altitude = up to 457 meters (1500 feet) above sea level.

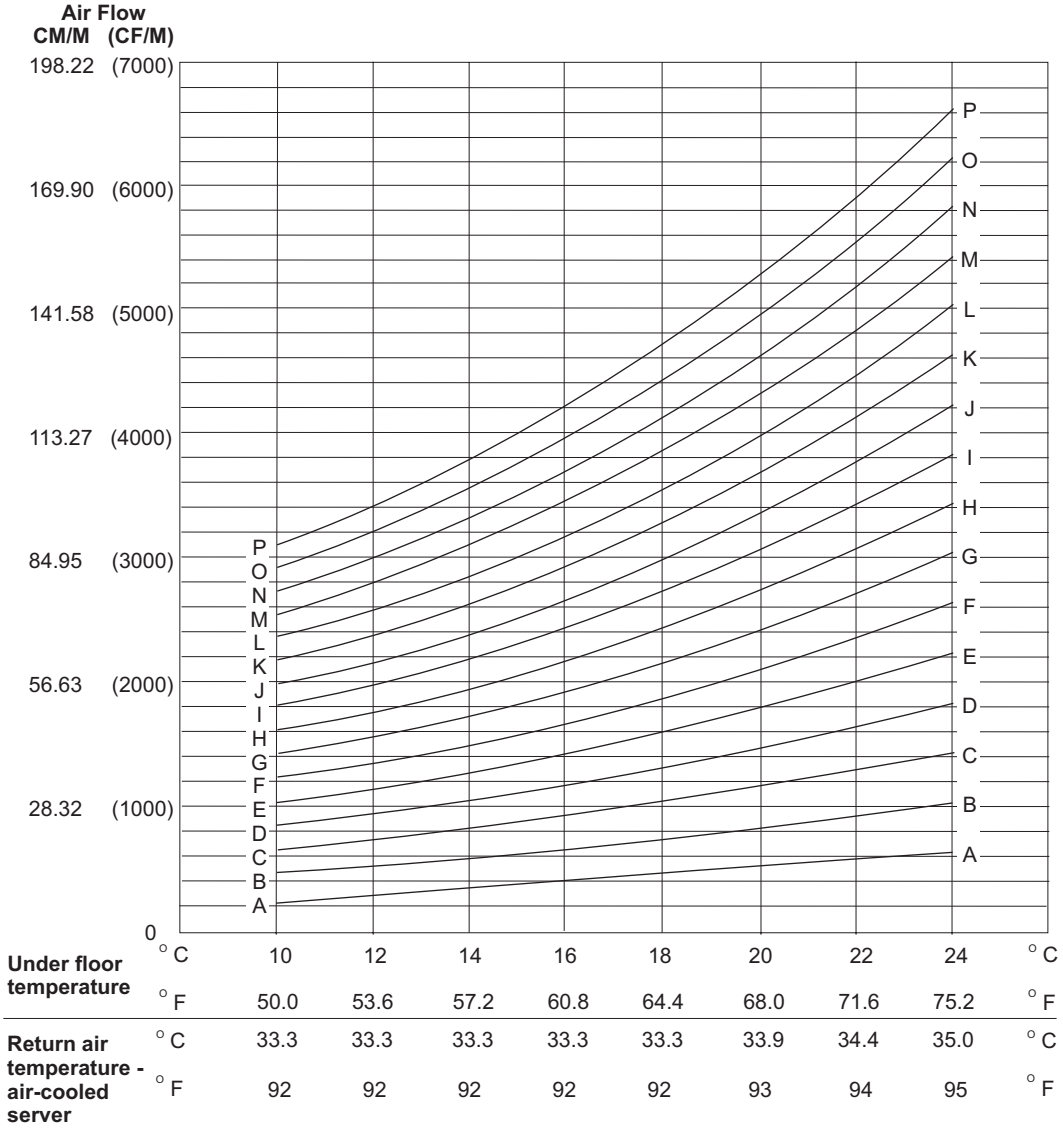


Figure 3. Cooling airflow graph

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

The proportion of server heatload removed to water is affected by the local ambient and dewpoint. For servers operating in 22º C to 27º C ambient and under 11º C dewpoint, water typically removes between 70% and 80 % of input power. When the ambient is below 18º C, the small temperature difference between exhaust air and cooling water temperature lessens rear heat exchangers' effectiveness. Servers with ambient above 27º 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 43 shows that, for each zEnterprise 196, 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, IBM recommends that the customer's facility meet the general guidelines published in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook*.

Special cooling recommendations for water-cooled machine

The zEnterprise 196 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 zEnterprise 196 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 z196.

1. Total Hardness must not exceed 200 mg/L as calcium carbonate.
2. pH must be between 7 and 9.
3. Turbidity must be less than 10 NTU (Nephelometric Turbidity Unit).
4. Bacteria must be less than 1000 CFUs (Colony Forming Unit)/ml.
5. Water to be as free of particulate matter as feasible.
6. Allowable system inlet water temperature range is 6-16 ^{0}C (43-61 ^{0}F), using standard building chilled water (BCW). A special water system for the 2817 is typically not required.
7. Required flow rate to the frame is 3.7 – 79.4 lpm (1 -21 gpm), depending on inlet water temperature and the number of nodes populated in the server. Colder inlet water temperatures require less flow then warmer water temperatures. Fewer nodes require less flow then maximum populated processors.
8. Minimum water pressure required across the IBM hose ends is 0.34 – 2.32BAR (5 – 33.7 psi), depending on the minimum flow required.
9. Maximum water pressure supplied at the IBM hose connections to the customer water supply should not exceed 6.89 BAR (100 psi).
10. Table 15 on page 54 and Table 16 on page 54 contain reference information to help you determine the facility water supply conditions for your particular server.

Supply hoses

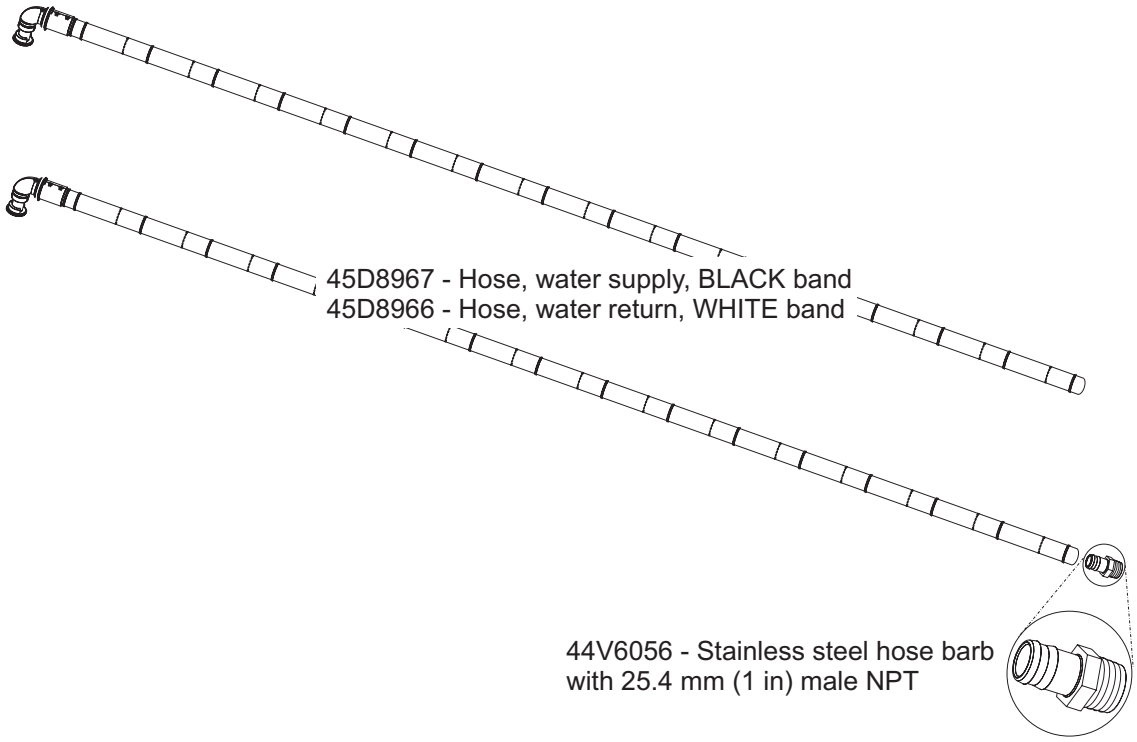
Important:

Water hoses, hose barbs and hose clamps are shipped with the zEnterprise 196 in a kit, **P/N 46K3709**. 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.**

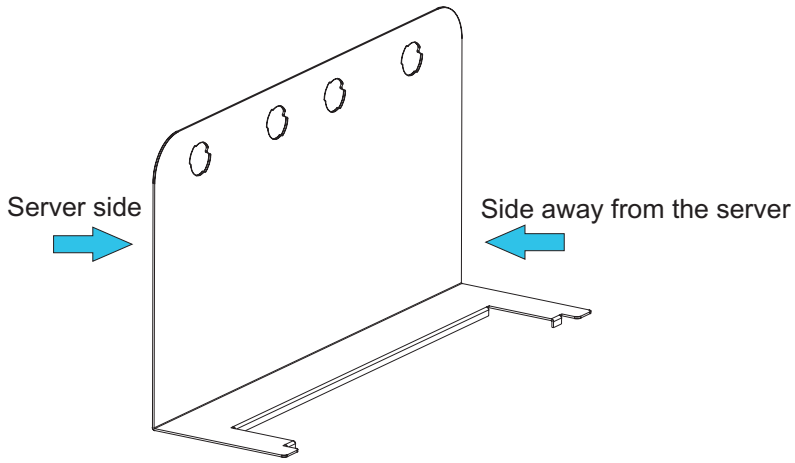
Although IBM does not make recommendations or suggestions on how to terminate the facilities side of the hose, we do provide parts that we have used successfully in our installations. If you have other preferred parts or termination methods, discard the parts provided with the server.

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 zEnterprise 196 under-floor water supply, IBM provides:

- 2 - each 4.2 m (14 ft) hoses, (**P/N 45D8967** and 2 - hoses **P/N 45D8966**).



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

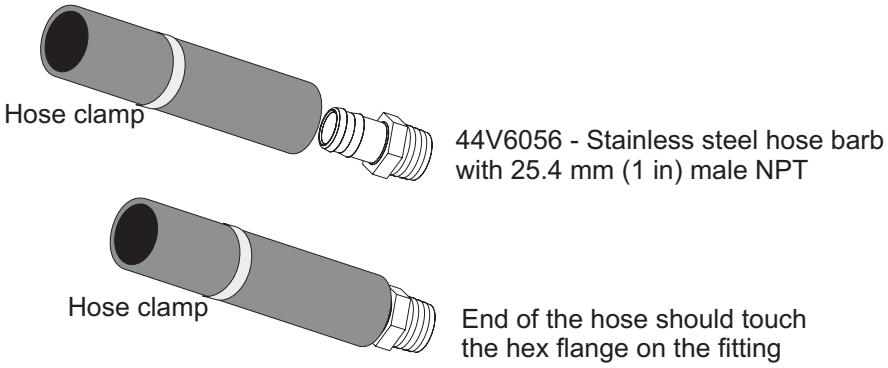


- 4 - spare O-rings, for Aeroquip quick connect couplings, **P/N 45D3158**.
- 6 - Oetiker hose clamps (2 are spares) **P/N 15R8650**.
- 1 - Oetiker crimping tool P/N **P/N 74Y0585** (Oetiker part number **14100082**)

For zEnterprise 196, we strongly suggest, but do not require, shut-off 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

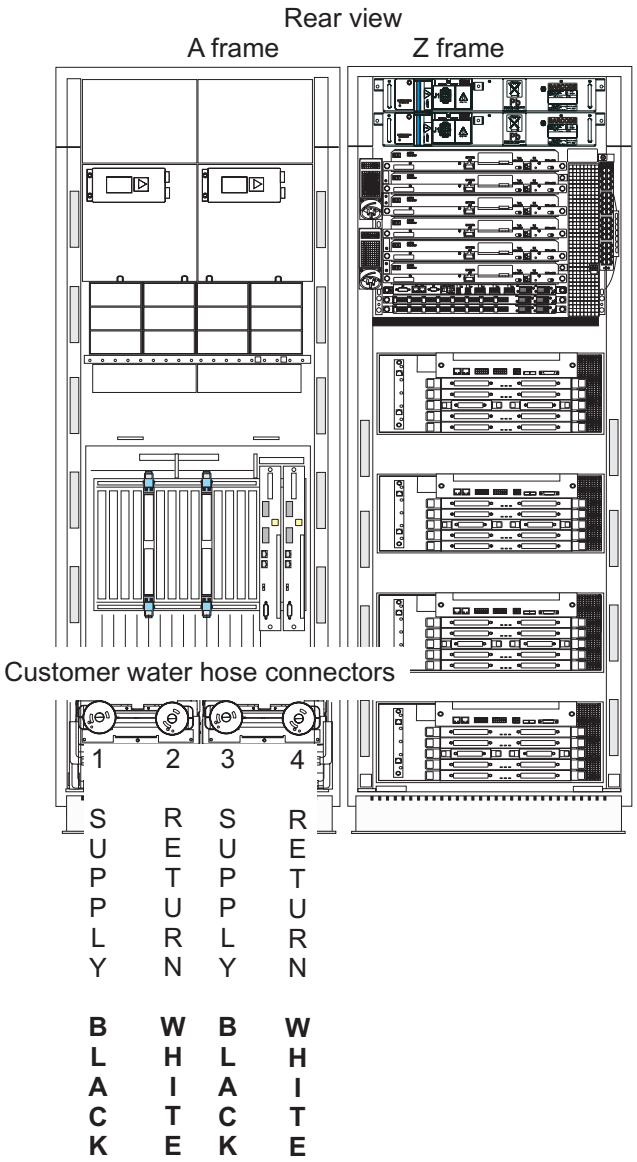
a specified orientation, the locating fixture, **P/N 74Y1090**, provided with the system, should be used while installing the hoses . This will position the quick connects in the proper orientation, with the faces of the quick connects parallel to the rear of the frame and the correct height off the 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.

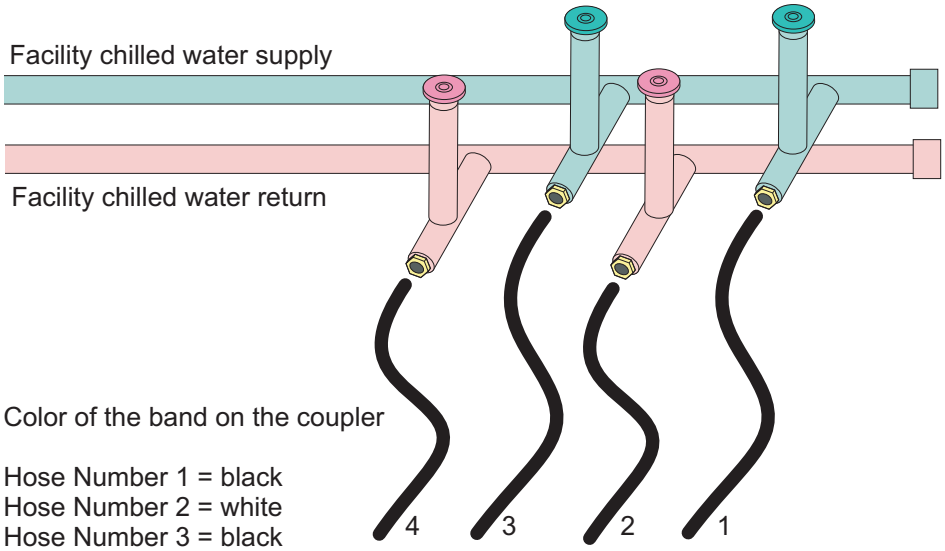
Water-cooled server hose connections, for the customer water supply, are located at the bottom rear of the A frame.



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.

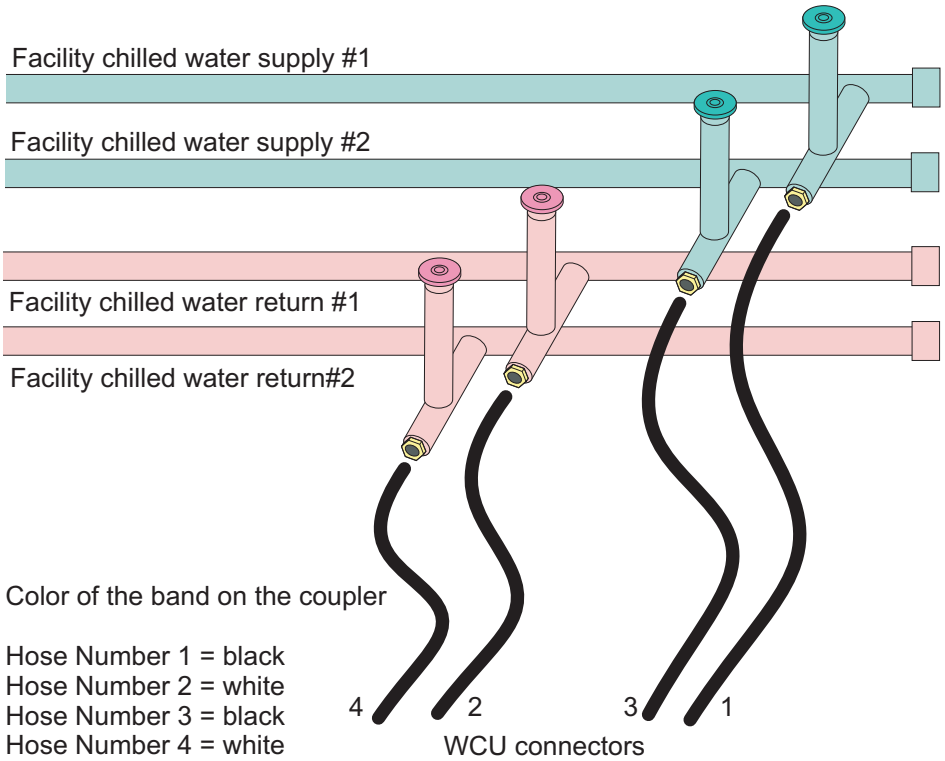
Typical customer water facility



Color of the band on the coupler

Hose Number 1 = black
Hose Number 2 = white
Hose Number 3 = black
Hose Number 4 = white

High availability customer water facility



Color of the band on the coupler

Hose Number 1 = black
Hose Number 2 = white
Hose Number 3 = black
Hose Number 4 = white

Materials used in the water cooling units

The customer side of the z196 WCU 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 13. 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 (being qualified by IBM materials dept.)
Quick Connects - body castings	stainless steel
Quick Connects - external O-ring	ERP (Ethylene Propylene Rubber)
Quick Connects - internal gaskets	ERP (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 14. Water hose materials

Description	Material
Aeroquip quick-connect - C-ring	ERP (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	ERP (Ethylene Propylene Rubber)
Aeroquip quick-connect - plastic face seal	poly carbonate (does not touch water)
Pig tail casting	aluminum bronze C61400
Pig tail hose - cover	carboxylated nitrile
Pig tail hose - reinforcement	synthetic, high tensile textile cord
Pig tail hose - tube	nitrile

Water specifications

The following table provides the requirements for the chilled water at the server connection.

Table 15. Required building chilled water conditions - (6° C - 11° C)

Number of nodes	Max KW to water	Chilled water per Water Conditioning Unit (Water-cooled U)	Building chilled water in ° C					
			6°	7°	8°	9°	10°	11°
1	7	**Flow (LPM)**	6.0	6.3	6.6	7.0	8.0	9.0
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.34
		Outlet temp ^{0} C	23	23	23	23	23	22
2	10	**Flow (LPM)**	8.5	9.5	10	11	12	13.5
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.34
		Outlet temp ^{0} C	23	22	22	22	22	22
3	14	**Flow (LPM)**	12.5	13.5	15	16.5	18	20
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.34
		Outlet temp ^{0} C	22	22	21	21	21	21
4	18	**Flow (LPM)**	17	18	20	22	24	27
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34	0.35
		Outlet temp ^{0} C	21	21	21	21	21	21
Note: Units are liters/minute, bars, and ^{0}C. These conditions must be available to each of the water conditioning units.								

Table 16. Required building chilled water conditions - (12° C - 16° C)

Number of nodes	Max KW to water	Chilled water per Water Conditioning Unit (Water-cooled U)	Building chilled water in ^{0} C				
			12^0	13^0	14^0	15^0	16^0
1	7	**Flow (LPM)**	10.0	11.5	13.5	16	20
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.34
		Outlet temp ^{0} C	22	22	21	21	21
2	10	**Flow (LPM)**	15	17	20	24	30
		Pressure Drop (Bar)	0.34	0.34	0.34	0.34	0.37
		Outlet temp ^{0} C	22	21	21	21	21
3	14	**Flow (LPM)**	22	25	30	35	
		Pressure Drop (Bar)	0.34	0.34	0.37	.50	
		Outlet temp ^{0} C	21	21	21	21	
4	18	**Flow (LPM)**	30	35	42	52	
		Pressure Drop (Bar)	0.37	.50	0.69	1.06	
		Outlet temp ^{0} C	21	20	20	20	
Note: Units are liters/minute, bars, and ^{0}C. These conditions must be available to each of the water conditioning units.							

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 1000 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.

Glycol will lower the thermal efficiency of heat exchangers. It's 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 z196 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 z196 into an existing multiple-system environment, or when adding additional systems to an installed zEnterprise 196, consider the following factors:

- **Thermal interactions**

  Although computer room floor space is valuable, for optimal cooling, it is recommended that zEnterprise 196 servers have a 1220 mm (48 in) aisle between rows of systems to reduce surrounding air temperature. See “Cooling recommendations for the room” on page 43.

- **Floor placement**

  The zEnterprise 196 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

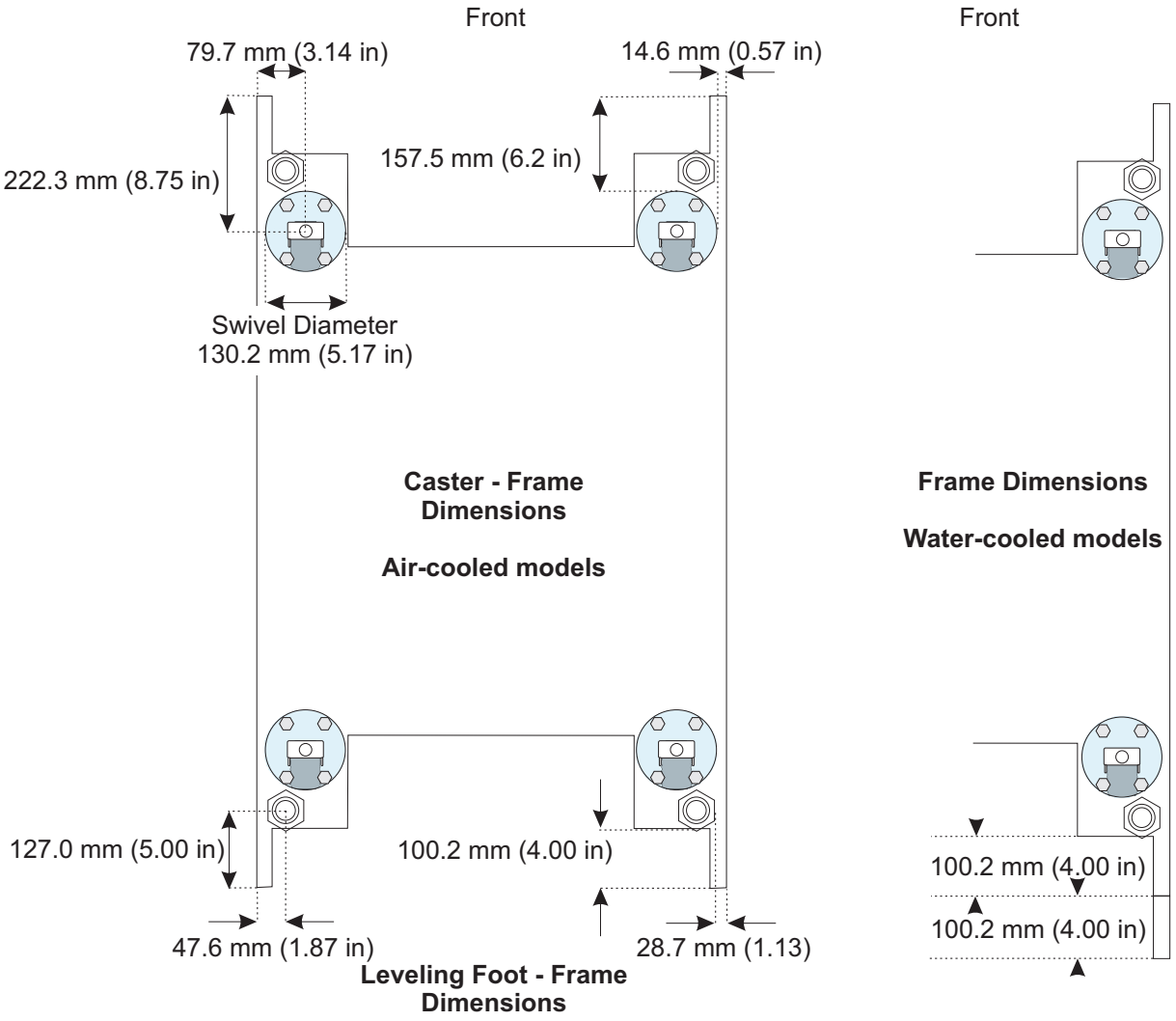
This chapter provides recommendations and requirements for making the necessary openings in the raised floor for installation.

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.

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 130 mm (5.1 in) in diameter. Exercise caution when working around floor cutouts.



Procedure for cutting and placement of floor panels

Important:

The zEnterprise 196 server, fully configured, can weigh in excess of 2268 kg (5000 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 or a structural engineer to verify that your raised floor is safe to support the z196.

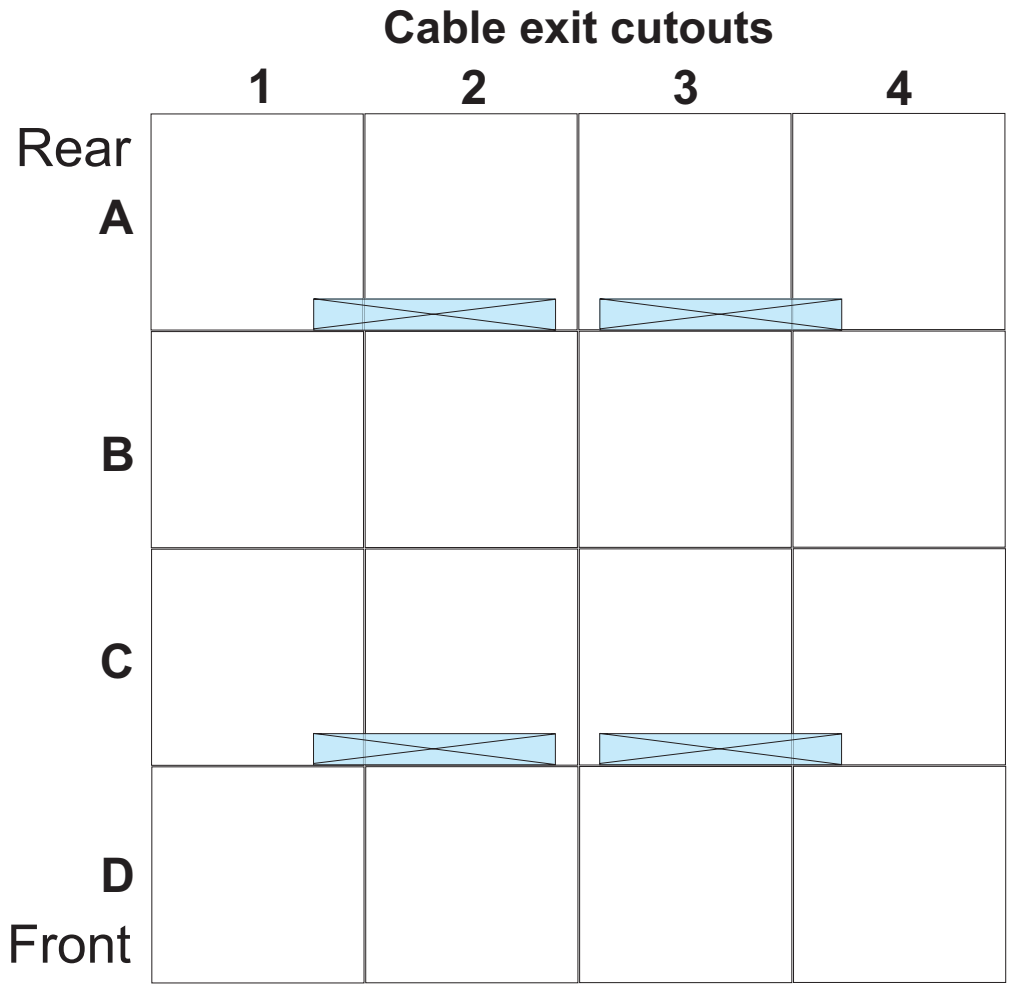
DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

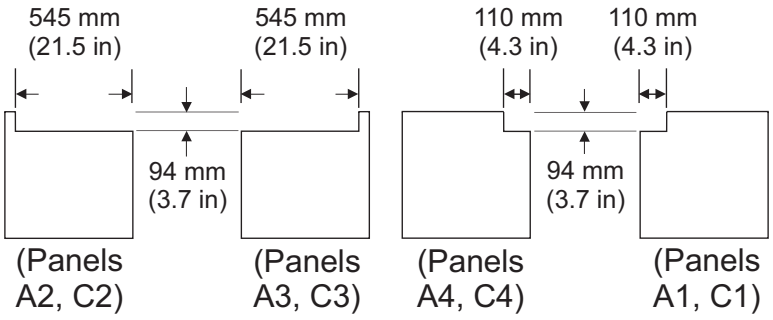
Depending on the floor panel type, additional panel supports (pedestals) may be necessary to maintain the structural integrity of an uncut panel, or to restore the integrity of a cut floor panel. Consult the panel manufacturer to ensure that the panel can sustain concentrated loads that can be as high as 408 kg (900 lbs) per caster for the z196 system. Under certain circumstances it is possible that two casters will induce a total load as high as 816 kg (1800 lbs) onto a single panel.

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

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





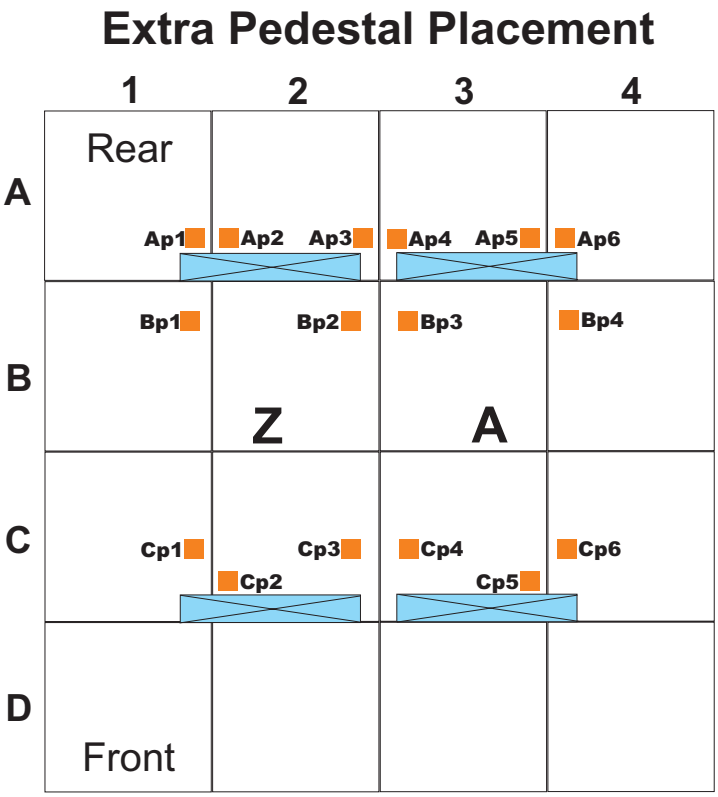
Frame Entry/Exit	Dimension	
	(mm)	(in)
Front	94 x 655	3.7 x 25.8
Rear	94 x 655	3.7 x 25.8

Important:

Extra pedestals may be placed as shown below:

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 8008** or **FC 8009**), or the weight distribution feature (**FC 9970**), 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.



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

zEnterprise 196 **may** require as many as 5 customer power feeds:

1. **Two** identical power cords to the Z frame - one to the front, one to the rear **for configurations using a total of six or less Bulk Power Regulators (BPRs)** or **four** identical power cords to the Z frame - two to the front, two to the rear **for all other configurations**. These power cords can be either three-phase AC or DC cords. 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 I/O drawers or cages, 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 3212, 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.
2. Refer to the Appendix D, "3-phase dual power installation," on page 123 for the correct wiring method for your particular power distribution equipment.
3. One single-phase feed for customer-supplied service outlets for the Hardware Management Console and its modem.
4. There are no power feeds to the A frame.

The service outlets require standard 100V to 130V or 200V to 240V, 50/60Hz, single-phase power.

Power installation considerations

zEnterprise 196 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 D, "3-phase dual power installation," on page 123 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. Since 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	180-509	47-63
Two or four redundant DC line cords	380-520	350-570	N/A

Source type	Frequency	Input voltage range (V)	Rated input current (A)
Three-phase (60A plug)	50/60 Hz	200 - 240V	48A
Three-phase (all except 60A plug)	50/60 Hz	380 - 415V	25A
Three-phase (all except 60A plug)	50/60 Hz	480V	20A
DC	N/A	380 - 520V	44A

I/O units

Table 17. I/O unit descriptions and values

Feature code	I/O unit description	I/O unit value
4000	I/O drawer - 5 EIA units tall. Holds 8 I/O adapters installed horizontally. Used in air-cooled models.	1
4002	I/O cage - 14 EIA units tall. Holds 28 I/O adapters installed vertically. Used in air-cooled models.	2
4003	PCIe I/O drawer - 7 EIA units tall. Holds 32 I/O adapters installed vertically. Used in air-cooled models.	1
4004	I/O drawer - 5 EIA units tall. Holds 8 I/O adapters installed horizontally. Used in water-cooled models.	1
4005	I/O cage - 14 EIA units tall. Holds 28 I/O adapters installed vertically. Used in water-cooled models.	2
4006	PCIe I/O drawer - 7 EIA units tall. Holds 32 I/O adapters installed vertically. Used in water-cooled models.	1
4016	I/O cage - 14 EIA units tall. Holds 28 I/O adapters installed vertically. Used in water-cooled models. Manufacturing feature code.	2
4018	I/O cage - 14 EIA units tall. Holds 28 I/O adapters installed vertically. Used in water-cooled models. Manufacturing feature code.	2
4020	I/O cage - 14 EIA units tall. Holds 28 I/O adapters installed vertically. Used in water-cooled models. Manufacturing feature code.	2

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 books and number of I/O units in the server configurations.

Table 18. Number of line cords required per side

	Number of I/O units [1, 2]						
	0	**1**	**2**	**3**	**4**	**5**	**6**
M15 **(1 processor book)**	1	1	1	1	1	1	1
M32 **(2 processor books)**	1	1	1	1	1	2	2
M49 **(3 processor books)**	1	1	2	2	2	2	2
M66/M80 **(4 processor books)**	2	2	2	2	2	2	2
See Table 17 on page 65 for I/O descriptions and values							

Table 19. Number of BPRs installed per side

	Number of I/O units [1, 2]						
	0	**1**	**2**	**3**	**4**	**5**	**6**
M15 **(1 processor book)**	1	1	1	2	3	3	3
M32 **(2 processor books)**	2	3	3	3	3	4	4
M49 **(3 processor books)**	3	3	4	4	4	4	5
M66/M80 **(4 processor books)**	4	4	5	5	5	5	5

Notes:

1. See Table 17 on page 65 for I/O descriptions and values
2. Current balance on the phases is determined by the BPR count in this table. The balance (or imbalance) is defined in Table 20 on page 67.

Table 20. Current balance per line cord

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

Notes:

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.
4. Only available with FC 3003 (balance power)_

Table 21. Current balance Model 15 example

Example 1 - Model 15 with 2 I/O units
From Table 19 on page 66, the number of BPRs per side = 1
From Table 20, the phase currents are unbalanced A on the first line cord set (there is no second line cord set.)

Table 22. Current balance Model 32 example

Example 1 - Model 32 with 4 I/O units
From Table 19 on page 66, the number of BPRs per side = 3
From Table 20, the phase currents are balanced on the first line cord set (there is no second line cord set.)

Table 23. Current balance Model 49 example

Example 1 - Model 49 with 6 I/O units
From Table 19 on page 66, the number of BPRs per side = 5
From Table 20, the phase currents are balanced on the first line cord set. The phase currents are unbalanced B on the second line cord set.

Table 24. Current balance Model 66 example

Example 1 - Model 66 with 5 I/O units
From Table 19 on page 66, the number of BPRs per side = 5
From Table 20, the phase currents are balanced on the first line cord set. The phase currents are unbalanced B on the second line cord set.

Table 25. Current balance Model 80 example

Example 1 - Model 80 with 1 I/O unit
From Table 19 on page 66, the number of BPRs per side = 4
From Table 20, the phase currents are balanced on the first line cord set. The phase currents are unbalanced A on the second line cord set.

Power specifications

The following tables provide system power consumption/heat load based on the number of processor books and number of I/O units in the server configurations. The data is shown for servers at sea level.

Real customer configurations will come out lower in the power estimator than the numbers in the table since 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.

As an example, a typical 4 book system in a typical data center would compute to about 19 kW in the estimator with data from the customer's eConfig output vs the absolute maximum of 27.4 kW in the table below.

Table 26. System power consumption - Air-cooled

	Number of I/O units [1]						
	0	**1**	**2**	**3**	**4**	**5**	**6**
Utility power - 1 processor book	6.0	6.9	7.8	10.2	12.5	13.0	13.7
Utility power - 2 processor books	10.0	11.1	12.0	14.2	16.3	17.1	19.2
Utility power - 3 processor books	13.9	14.8	15.7	17.9	20.0	20.8	22.9
Utility power - 4 processor books	18.4	19.3	20.3	22.4	24.5	25.3	27.4

Notes:

1. See Table 17 on page 65 for I/O descriptions and values
2. Assumes maximum supported configuration (maximum I/O adapters installed)
3. The power factor is approximately unity.
4. Input power (kVA) equals heat output (kW).
5. For heat output expressed in kBTU per hour, multiply table entries by 3.41.
6. See Appendix D, “3-phase dual power installation,” on page 123 for recommendations on utility connections which better balance the current for installations where multiple systems are connected to the same power panel.

Table 27. System power consumption - Water-cooled cooling

	Number of I/O units [1]						
	0	**1**	**2**	**3**	**4**	**5**	**6**
Utility power - 1 processor book	5.5	6.4	7.1	9.7	12.1	12.5	13.2
Utility power - 2 processor books	8.7	9.9	10.8	13.0	15.0	15.8	17.9
Utility power - 3 processor books	11.8	12.7	13.5	15.8	17.8	18.6	20.7
Utility power - 4 processor books	15.3	16.3	17.0	19.3	21.3	22.1	24.2

Notes:

1. See Table 17 on page 65 for I/O descriptions and values
2. Assumes maximum supported configuration (maximum I/O adapters installed)
3. The power factor is approximately unity.
4. Input power (kVA) equals heat output (kW).
5. For heat output expressed in kBTU per hour, multiply table entries by 3.4.
6. See Appendix D, “3-phase dual power installation,” on page 123 for recommendations on utility connections which better balance the current for installations where multiple systems are connected to the same power panel.
7. The power advantage from using water cooling increases with the size of the system.

Power estimation tool

The power estimator tool for the zEnterprise 196 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 server.

Log on to Resource Link with any user ID. Navigate to **Planning**, then to **Tools**, then to **Power Estimation Tools**. 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 on the HMC System Activity Display.

Power capping

zEnterprise 196 supports power capping, which gives the customer the ability to limit the maximum power consumption and reduce cooling requirements (especially with zBx). To use power capping, FC 0020, Automate Firmware Suite, must be ordered. This feature is used to enable the Automate suite of functionality associated with the IBM zEnterprise 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, zIIPs, and zAAPs.

Customer circuit breakers (CBs)

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

Input voltage range (V)	System rated current (A)	Circuit breaker
208 - 240VAC	48A	60A/63A W/T
380 - 415VAC	25A	25A W/T
480VAC	20A	30A
380 - 520VDC	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: System z server design incorporates Electromagnetic Interference filter capacitors required to block electrical noise from penetrating the power grid. A characteristic of filter capacitors, during normal operation, is high leakage currents. Depending on the server configuration, this leakage current can reach 350mA (350 milliamps). For most reliable operation, **Ground Fault Circuit Interrupter (GFCI), Earth Leakage Circuit Breaker (ELCB) or Residual Current Circuit Breaker (RCCB) type circuit breakers are not recommended for use with System z servers.** By internal design and grounding, System z servers are fully certified for safe operation (compliance with IEC, EN, UL, CSA 60950-1).

However, if leakage detection circuit breakers are required by local electrical practice, **the breakers should be sized for a leakage current rating not less than 500mA** in order to reduce the risk of server outage caused by erroneous and spurious tripping.

Internal battery feature (FC 3212)

The Internal Battery Feature (IBF), FC 3212, is optional on the zEnterprise 196. 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 28. IBF holdup times

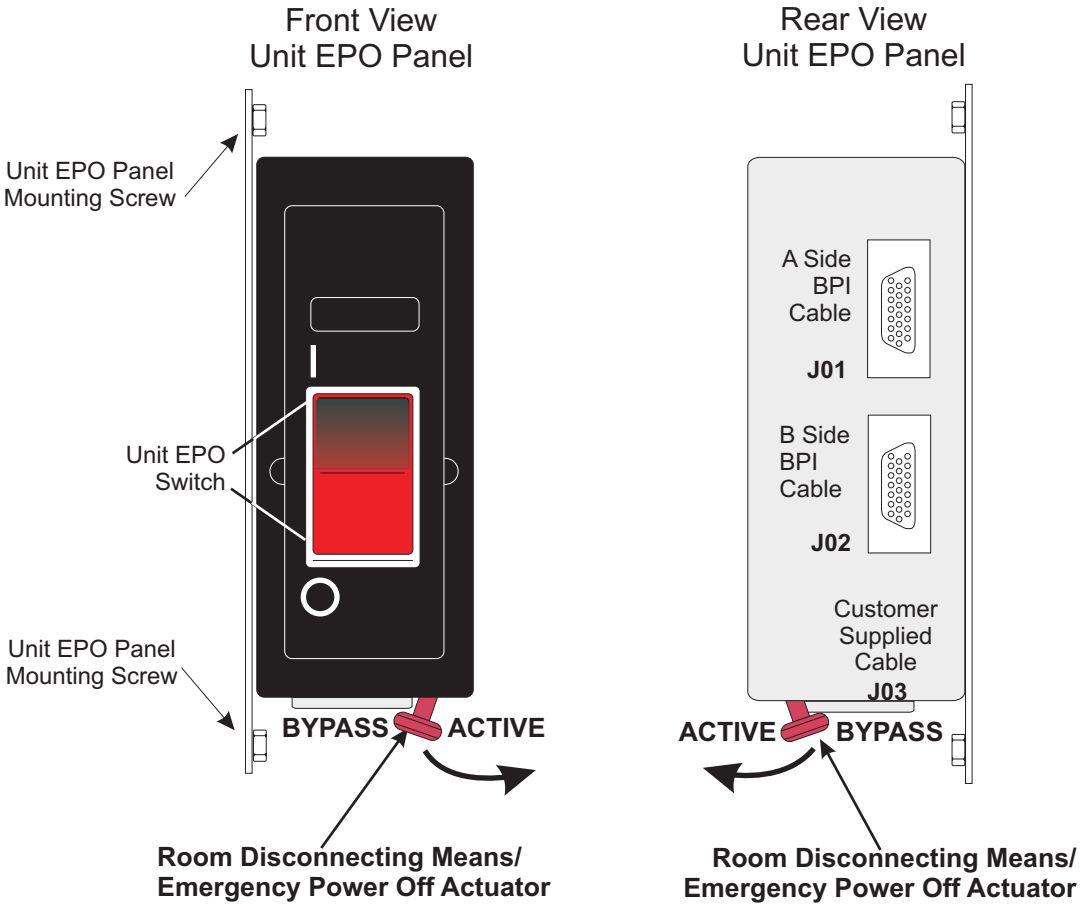
	Number of I/O units						
	0	**1**	**2**	**3**	**4**	**5**	**6**
1 processor node	7 min	5.3 min	4.3 min	9.0 min	13.0 min	10.2 min	10.1 min
2 processor nodes	9.3 min	14.0 min	13.0 min	10.0 min	8.0 min	7.5 min	6.7 min
3 processor nodes	10.1 min	9.5 min	8.8 min	7.0 min	6.0 min	5.4 min	5.0 min
4 processor nodes	6.9 min	6.4 min	6.0 min	5.0 min	4.3 min	4.0 min	3.5 min

Notes:

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 connected to the Bulk Power Regulators associated with the Section 1 power cords.
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 Bulk Power Regulators (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.

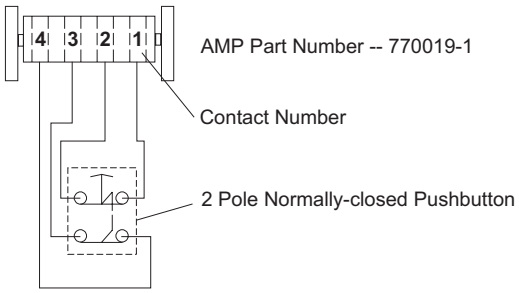


This figure illustrates both the front and the rear of the machine UEPO panel. The rear view shows where the room electrical power disconnecting means, or room Emergency Power Off, EPO, cable plugs into the machine. Notice the switch actuator. Once moved to make the cable connection possible, the room 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.



Room UEPO Switch Schematic

In this figure 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 lengths are 4250 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.

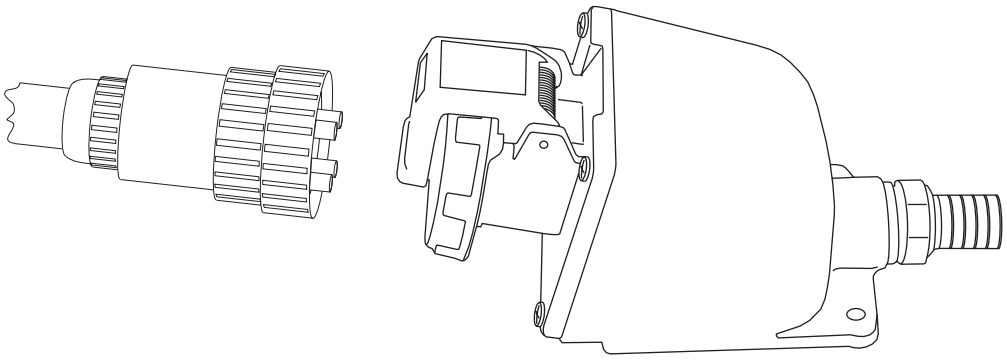
Important:

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 a is 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**.

System location	Supported power cord feature codes [3]	Watertight plug	Watertight receptacle
USA, Canada, Japan (200-240 VAC)	8993	60A IEC-309 (provided as part of the cord)	60A IEC-309 460R9W (not provided)
USA, High Voltage (480 VAC)	8983	30A IEC-309 (provided as part of the cord)	30A IEC-309 430R7W (not provided)
World Trade (208-240 VAC)	8982 8996	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)
World Trade (380-415 VAC)	8988 8998	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)
USA, Canada, Japan (380-520 VDC)	8963	60A (provided as part of the cord)	360R8WDC (not provided)
World Trade (380-520 VDC)	8965	No plug provided. Cut end cord. Plug is provided by the customer and is electrician-installed.	(not specified)

Notes:

1. IBM continues to strongly recommend the use of a metal backbox (example shown below) with our line cords using IEC-309 plugs. Although inline 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 mis-wired 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 77 for descriptions of the power cord feature codes.

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. IBM recommends 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.

There is information about additional recommendations and requirements for equipment grounding on IBM's **Resource Link** at *http://www.ibm.com/servers/resourcelink*. See "**General Information for Planning a Physical Site**".

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 14 ft	8963	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
World Trade (380-520 VDC) 14 ft	8965	#6 AWG Type PPE	1 (overall gross shield)	No	28.5 (1.12)
World Trade, low voltage (200-240 VAC) 14 ft	8982	#6 AWG Type DP-1	1 (overall gross shield)	No	28.5 (1.12)
USA, Canada, Japan (200-240 VAC) 60A 14 ft	8993	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
USA, high voltage (480 VAC) 30A 14 ft	8983	#10 AWG Type DP-1	1 (overall gross shield)	Yes	14.48 (0.57)
World Trade, low voltage (200-240 VAC) 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) 14 ft low smoke, halogen-free	8998	#10 AWG Type LSZH	1 (overall gross shield)	No	15.00 (0.59)
World Trade, high voltage (380-415 VAC) 14 ft	8988	#10 AWG Type DP-1	1 (overall gross shield)	No	14.48 (0.57)

Notes:

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.
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.

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.

Service outlet (customer-supplied)

A duplex service tool outlet should be installed within 1.5 m (5 ft) of the system frame. The power requirement is 110V/120V for USA and Canada (other power requirements are country dependent). The service tool outlets should be fed from the same power source as the system. The service tool outlet should be placed on a separate circuit breaker so it can be used when the processor frame circuit breaker is off.

Chapter 6. Hardware Management Console and Support Element communications

Support Element

The zEnterprise 196 is supplied with a pair of integrated ThinkPad Support Elements (SEs). One is always active while the other is strictly an alternate. Power for the Support Elements is supplied by the server power supply, and there are no additional power requirements.

Unlike many previous servers, the internal LAN for the Support Elements on the zEnterprise 196 server connects to the Bulk Power Hub in the Z frame. There is an additional connection from the hub to the Hardware Management Console utilizing the VLAN capability of the server.

Hardware Management Console

As a minimum requirement, Hardware Management Console FC 0084 is required to operate a zEnterprise 196 server and will require upgraded memory capacity. FC 0091 is the HMC that will ship on new orders. A single console can support multiple zEnterprise 196, z10®, z9®, zSeries, and S/390 servers and can be located remotely to the physical sites.

If you plan to use the ensemble capabilities of the zEnterprise 196, you will need to order FC 0025, Unified Resource Manager, and provide two additional HMCs, one to serve as the primary HMC for the ensemble, one to serve as the alternate HMC.

The machine type and model number of the primary HMC and alternate HMC must be identical. Both must be **either** Feature Code 90 **or** Feature Code 91. Verify this information by viewing the label on top of the HMC hardware tower (i.e. MTM: 7327-PAA).

The Hardware Management Console 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 (described below)
- A keyboard and
- A mouse.

The console requires a customer-supplied table to hold the following:

- The keyboard and mouse
- A 22-inch flat panel display, 22.0 inches viewable (FC 6096)
- Possibly, a modem. Some geographies will still receive an external modem, while most will include an internal modem.

The Hardware Management Console requires three 110/120V outlets for USA and Canada. (Other power requirements are country dependent.)

You may select from zero to ten Ethernet switches, FC 0070, on your server order. There is no default selection for FC 0070. FC 0070 will be allowed to carry forward from a previous server, but cannot be ordered against the 2817.

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 119. Physical specifications for the IBM 7852-400 modem are located in “Modems” on page 137.

IBM Hardware Management Console Feature Codes 0084, 0090, and 0091 can all be used on the zEnterprise 196.

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.

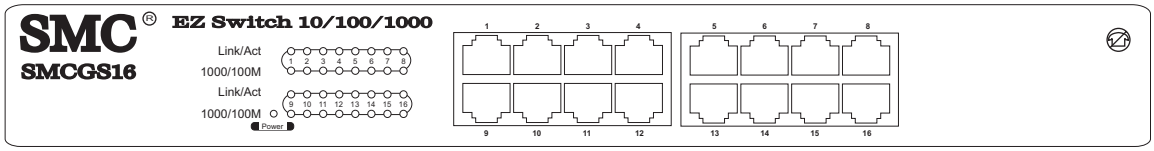
The Switch is a standalone unit located outside the frame and which operates on building AC power. The particular unit you have received is based on availability at the time of shipment. A customer-supplied switch may be used as long as it matches the specifications of the switch IBM supplies.

Typical Ethernet Switch characteristics:

- 16 auto-negotiation ports
- 10/100/1000 Gigabit 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.

Switch Example



Ethernet network connection requirements

MUST READ:

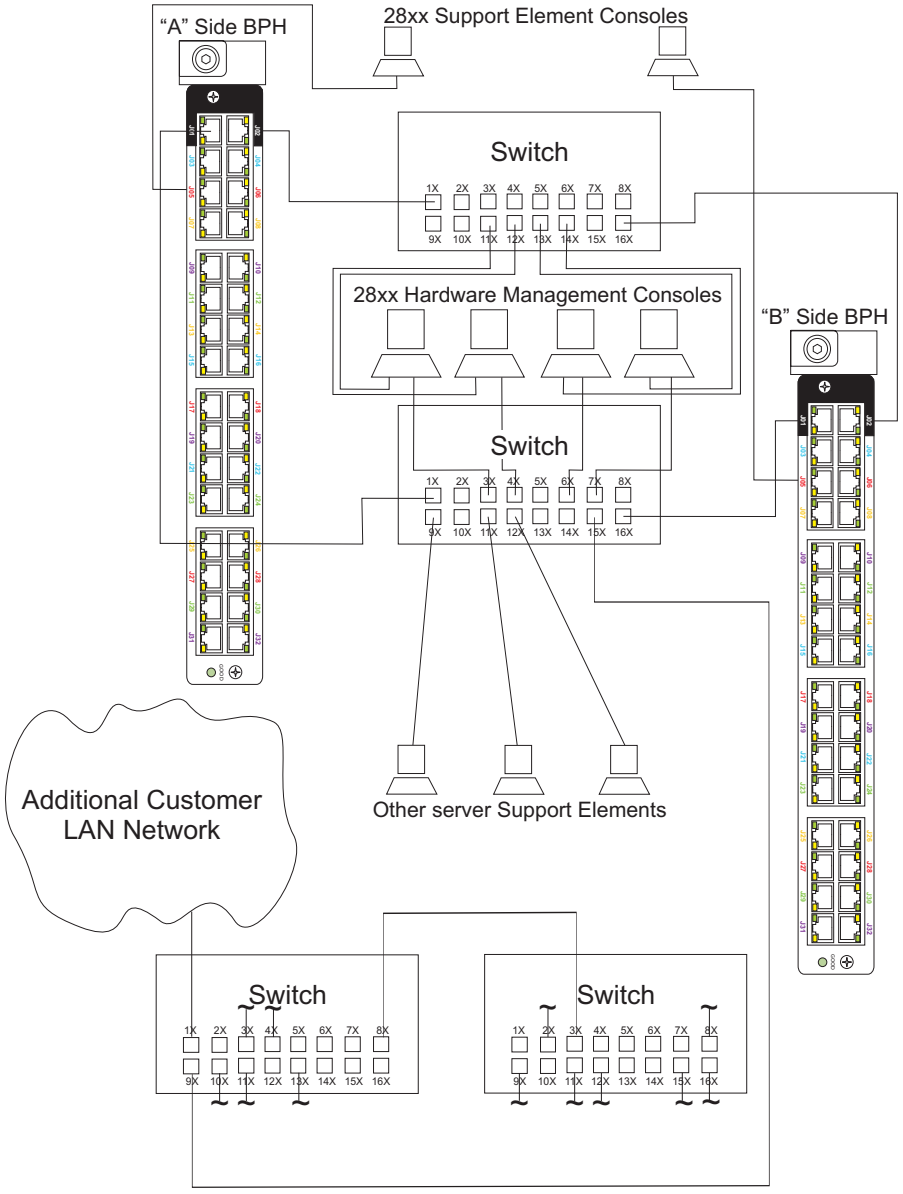
This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks.

Important:

On the zEnterprise 196, the install team must connect the Ethernet adapters for any HMC(s) into an Ethernet switch. This switch can then be connected to J01 and J02 on the Bulk Power Hubs. (See the illustration below).

IBM offers an Ethernet switch under Feature Code 0070. For z196, there is no default quantity for FC 0070. You must specify how many Ethernet switch Feature Codes 0070 you want on your server order. You may also use another manufacturer's switch, or an existing switch instead. Regardless of whose switch you use, there must be a switch available to connect the Hardware Management Consoles to your LAN.

To provide redundancy for the HMC(s), two switches should be used.

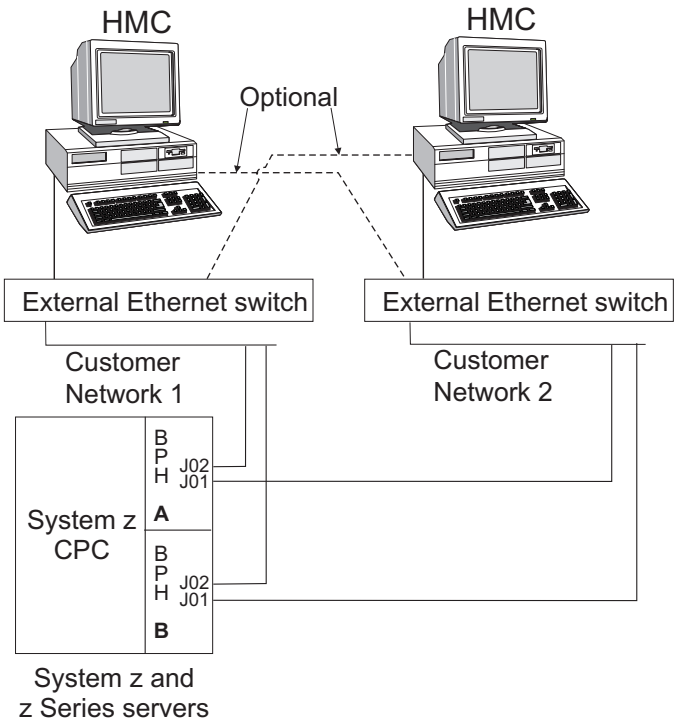


This configuration is required since the Support Elements have no external connection to the HMCs, and communicate only through the Bulk Power Hubs.

Notes:

1. Only Ethernet switches can connect to the customer ports J01 and J02 on the Bulk Power Hubs.
2. Never connect an HMC directly to J01 and J02 on the Bulk Power Hubs.
3. Never connect customer LANs to any ports other than J01 and J02 on the Bulk Power Hubs.
4. Customer **LAN 1 should be plugged into J02** on the Bulk Power Hubs. Customer **LAN 2 should be plugged into J01** on the Bulk Power Hubs.

The following illustration provides general System zEnterprise 196 Ethernet cabling information and is not intended to illustrate connection to a particular network.


HMC
HMC
Optional
External Ethernet switch
External Ethernet switch
Customer
Network 1
Customer
Network 2
System z
CPC
BPH
J02
J01
A
BPH
J02
J01
B
System z and
z Series 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. Multiple Ethernet LAN adapters in a Support Element allow two different Hardware Management Consoles to have independent paths to that SE, or to provide redundant paths from one HMC to that SE. The intent is to help ensure a path to the server from an HMC if there is a failure or outage in one of the networks.
3. When configuring multiple adapters the address must be defined in different subnets.

Because HMC FCs 0084, 0090, and 0091 only come with dual Ethernet features, no additional explanation of wiring scenarios is offered here.

Trusted key entry (TKE)

The zEnterprise 196 server may have a Crypto Express3 feature for applications where extensive data security is required. For these systems, there is a separate console available for authorized access to the Crypto Express3 feature. This console is named the Trusted Key Entry (TKE) workstation.

The TKE workstation, FC 0841, includes a system unit, (22 inch) flat panel display, mouse, keyboard, and line cord. 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.

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, 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:

1. The Smart Card Reader (SCR) is an optional security device that attaches to the TKE.
2. The Smart Card Reader provides swipe card function thus further restricting access to the TKE.
3. Feature Code 0885, 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.
4. A TKE workstation and the TKE 7.0 or later level code are co-requisites for ordering the Smart Card reader.
5. Any existing TKE workstation with a code level lower than 7.0 will have to be replaced with a FC 0841 workstation to work with your zEnterprise 196 server.
6. FC 0884 provides the ability to order additional blank Smart Cards. The Smart Card Reader is a co-requisite for ordering additional Smart Cards.

To use the TKE function on zEnterprise 196 servers, the Crypto Express3 feature, TKE 7.1 code (FC 0867), 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 this z196 in an ensemble, you must order FC 0025, which supplies the ensemble management code, and you must supply two HMCs, which must be either two FC 0090 or two FC 0091, to manage the ensemble. One of these HMCs is configured as the primary for the ensemble, one as the alternate. This applies to an ensemble with or without a zEnterprise BladeCenter® Extension (zBX).

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 2817 without a zBX, and if LPAR to LPAR communications is required in a Unified Resource Manager defined VLAN, you must supply two LC Duplex directly-connected cables (not wrap cables, as was previously recommended). Those LC Duplex directly-connected cables plug into the two OSA-Express3 10 GbE features (CHPID type OSX).

Notes:

1. When a z196 and FC 0025 (Unified Resource Manager) are ordered without a zBX, eConfig does not force you to order two OSA-Express3 10 GbE features, however those OSA features (either FC 3370, Long Reach or FC 3371, Short Reach) are required if you plan to use them for LPAR to LPAR communication.
2. The IODF must be shared among participating z/OS® LPARs.
3. LC Duplex loop back cables can be purchased online. If you have Long Reach 10 GbE OSAs (FC 3370 - 9 micron single mode), purchase Long Reach loop back cables. If you have Short Reach 10 GbE OSAs (FC 3371 - 50 or 62.5 micron multimode), purchase Short Reach loop back cables.

Ensemble network configurations for a zEnterprise 196 are as follows:

- Customer-managed management network (with or without zBX)
  - A pair of HMCs (FC 0090 or 0091 with Unified Resource Manager, FC 25) 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) (with or without zBX)
  - Two ports from two different OSA-Express3 1000BaseT Ethernet adapters (for redundancy) to provide management capability for a single node through the Unified Resource Manager.
- Intraensemble data (IEDN) network (**OSX** CHPID) (with or without zBX. If without, only if planning for LPAR to LPAR communications)
  - A pair of OSA-Express3 10 GbE adapters (for redundancy).
  - A pair of 10 Gb loop back cables (customer-supplied) to allow the System z applications to share data on the IEDN between operating system images.
- Customer network connections (**OSD** CHPID) (with or without zBX)
  - For existing network connectivity from System z applications to networks other than the IEDN.

Chapter 7. Remote Support Facility (RSF) installation planning

The Remote Support Facility (RSF) provides communication to a centralized IBM support network for problem reporting and service, as well as providing a means for remote operation of the Hardware Management Console. You may use either an Internet or modem connection for communicating with IBM's Remote Support Facility.

Note that there are some specific services for which a modem is required, rather than an Internet connection:

- External Time Source
- Auto Answer - if specifically enabled, to allow a customer to access the HMC remotely from an external location.

Note: For additional modem information, see Appendix G, "Modem support information," on page 137.

Choosing a communications method for remote support

You must choose method for connecting your server to IBM's Service Support System through the Remote Support Facility (RSF):

- 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. This method is highly recommended as the best choice for your RSF 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. This method is also highly recommended as a good choice for your RSF connection.
- Use a modem. This method, compared to a direct or indirect Internet connection, is more costly (telephone line, associated equipment, and monthly charges) and slower. The use of a modem restricts the functionality of the Remote Support Facility. Electronic fixes for some microcode components can only be supplied by a broadband connection to IBM

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 IBM's Service Support System.
- All transferred data is encrypted in a high-grade Secure Sockets Layer (SSL) method.
- When the HMC initiates a connection to RSF, it validates the trusted host by its digital signature issued for the IBM Service Support System.
- Data sent to IBM 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 SSL 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 destinations described under "Server address lists," 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. You can configure the proxy server to limit the specific IP addresses to which the HMC can connect. See the "Server address lists" for the IP addresses to use.

Server address lists

Whether you are using a direct connection (the HMC only) or an indirect connection (with a proxy server) for Internet access, the HMC utilizes the following IP addresses and port 443 for all Internet activity:

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

Table 29. IPv4 addresses

LMC 2.10.1 and later IPv4 addresses
129.42.26.224
129.42.34.224
129.42.42.224

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.

| If the customer requires that the alternate HMC and the primary HMC are to be connected to different
| switches, 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:

Table 30. IPv6 addresses

LMC 2.10.0 and later IPv6 addresses
2620:0:6C0:1::1000
2620:0:6C1:1::1000
2620:0:6C2:1::1000

Chapter 8. Cabling and connectivity

Cable Installation Planning:

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.

Following are:

- 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 zEnterprise 196 channel feature connections.
- A description of the Fiber Quick Connect fiber harness feature for ESCON and FICON cables.

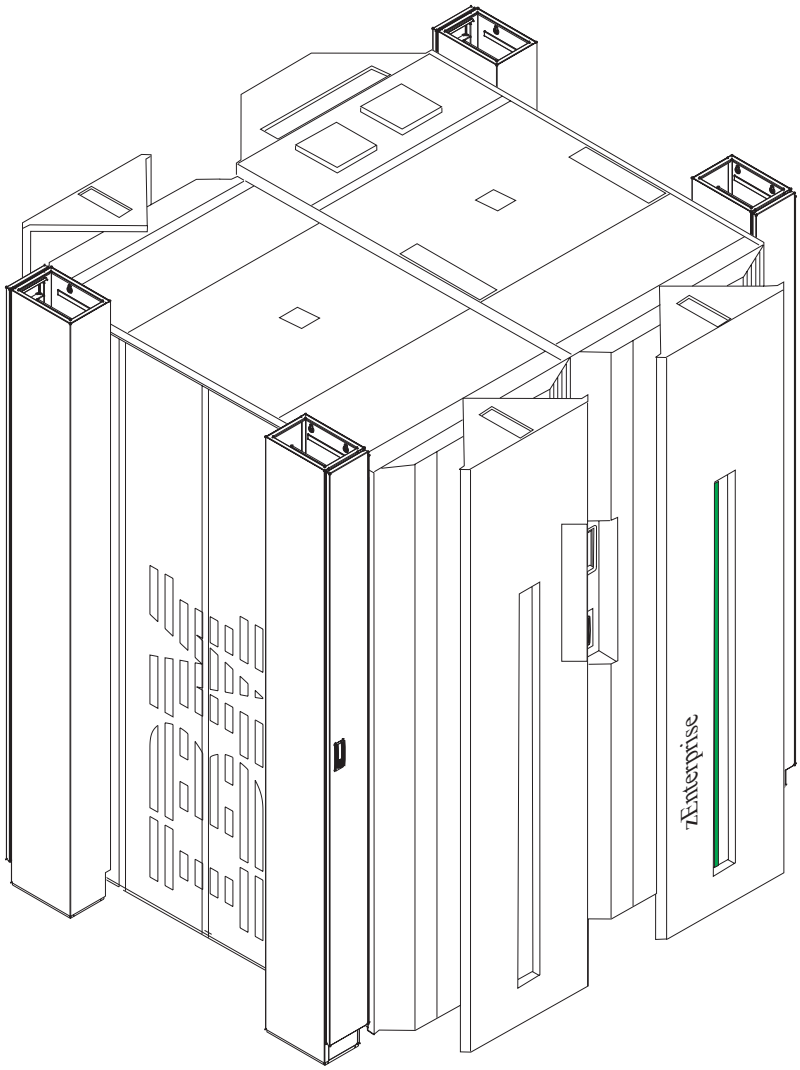
Top exit I/O cabling

The z196 has an optional feature for top exit I/O cabling. These frame towers for I/O top exit will add approximately 86 kg (190 lbs) to the server weight, 304 mm (12 inches) to the width, and 117 mm (4.6 in) to the height.

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

The top exit towers are installed as shown below.

Level 02f



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 System zEnterprise 196 , System z10, System z9, and zSeries (for example, ESCON, 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 zEnterprise 196, 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.

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. 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.

FICON channel feature

The FICON Express8S feature and the FICON Express8 feature deliver up to 8 Gbps link data rate to servers, switches, control units and storage devices. The FICON Express4 feature delivers up to 4 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. FICON channels can coexist with ESCON channels on z196 server models.

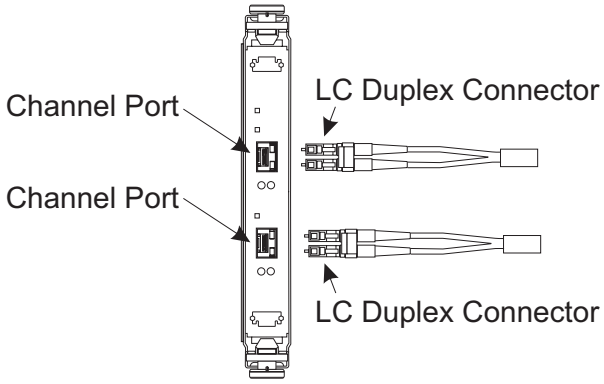
Configuration information

The table below lists the FICON features. These features support two modes of operation:

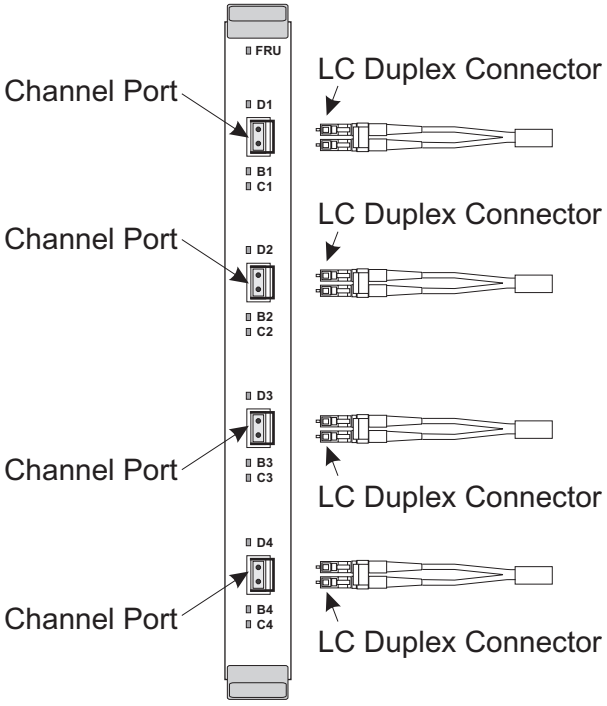
- FC - native FICON
- FCP - Fibre Channel Protocol - attachment to SCSI disks in Linux on z196 and z/VM® environments.

Feature Code	Description	Fiber Type
0409 (2 ports)(PCIe)	FICON Express8S LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 KM / 6.2 MI)
0410 (2 ports)(PCIe)	FICON Express8S SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
3325 (4 ports)	FICON Express8 LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 KM / 6.2 MI)
3326 (4 ports)	FICON Express8 SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
3321 (4 ports)	FICON Express4 LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 10 KM / 6.2 MI)
3322 (4 ports)	FICON Express4 SX (Short Wavelength)	multimode 50 and 62.5 micron (variable - maximum 860 m / 2822 ft))
3324 (4 ports)	FICON Express4 LX (Long Wavelength)	single mode 9 micron (unrepeated distance - 4 KM / 2.5 MI)

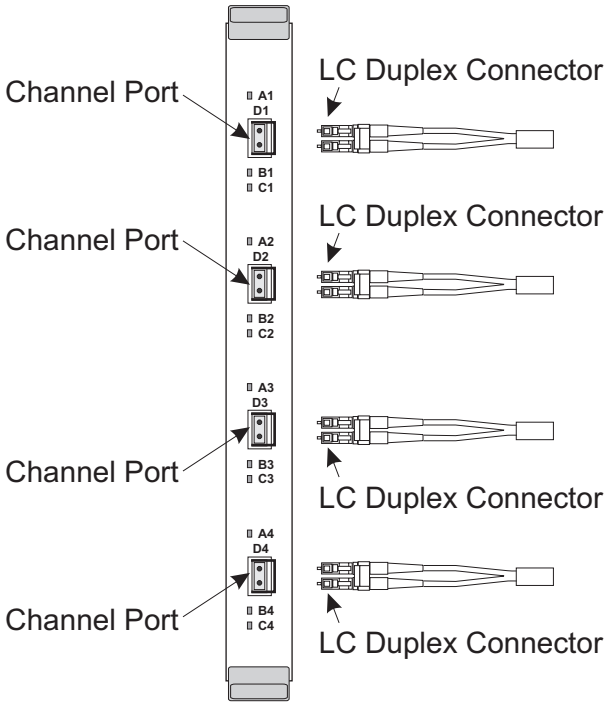
FCs 0409/0410
FICON Express8S



FCs 3325/3326
FICON Express8



FCs 3321/3322/3324
FICON Express4



Notes:

1. PCIe FICON Feature Codes 0409 and 0410 have two channels per feature.
2. FICON Feature Codes 3319, 3320, 3321, 3322, 3324, 3325, and 3326 have four channels per feature.

3. All FICON Express feature codes use LC Duplex connectors.
4. Each Feature Code represents a FICON base adapter with pluggable optic modules.
5. Short wavelength and long wavelength optic modules cannot be mixed on the same FICON base adapter.
6. Short wavelength and long wavelength features (FICON adapters) can coexist in the same I/O cage.

See "FICON references" for information about link distances and light loss budget.

FICON references

For additional information on planning for FICON channels see:

- *System z Planning for Fiber Optic Links (ESCON, FICON, Coupling Links, and Open System Adapters)*, GA23-0367
- *System z Fibre Channel Connection (FICON) I/O Interface Physical Layer*, SA24-7172
- *System z ESCON and FICON Channel-to-Channel Reference*, SB10-7034.

ESCON channel feature

Note: IBM Global Technology Services, through IBM Facilities Cabling Services, offers ESCON to FICON Migration (Offering ID #6948-97D), to help facilitate migration to FICON to simplify and manage a single physical and operational environment while maximizing "green" related savings.

The ESCON channel delivers up to 17 MB/sec link data rate to servers, switches, control units and storage devices. ESCON channels can coexist with FICON on all zEnterprise 196 server models.

The z196 system uses the 16 port ESCON feature. Fifteen of the ports are used. The sixteenth port is reserved as a spare.

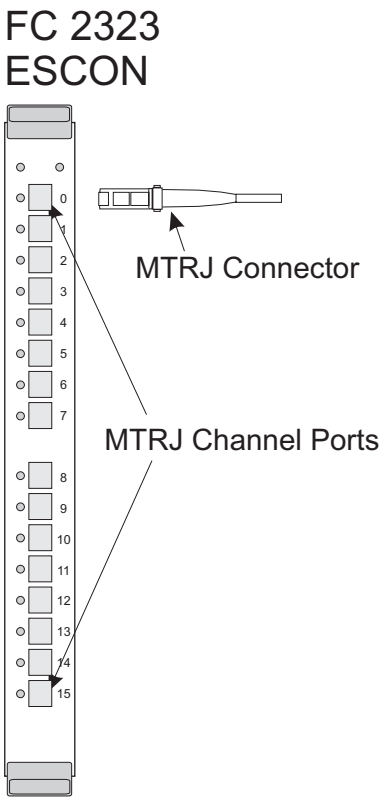
Configuration information

The table below shows the ESCON feature description

Feature Code	Description	Fiber type	Connector type
FC 2323	16-Port ESCON (15 ports plus 1 spare)	Multimode 62.5 micron	MT-RJ

- Use FC 2324 to order channels in 4-port increments.
- The system configuration tool places FC 2324s across an appropriate number of ESCON cards for high availability.
- See "ESCON references" on page 97 for information about link distances and light loss budget.

The following illustration shows the ESCON feature, the ports on the feature, and the type of fiber optic connector used.



ESCON references

For additional information on planning for ESCON channels see:

- *System z Planning for Fiber Optic Links (ESCON, FICON, Coupling Links, and Open System Adapters)*, GA23-0367
- *System z Fibre Channel Connection (FICON) I/O Interface Physical Layer*, SA24-7172
- *System z ESCON and FICON Channel-to-Channel Reference*, SB10-7034.

ISC-3 link feature

ISC-3 links provide Parallel Sysplex® connectivity between a coupling facility and production systems using z/OS operating systems. ISC-3 links operate at 2 Gbps in peer mode (connection between zEnterprise 196, z114, z10 EC, z10 BC, z9 EC, z9 BC, z990, or z890 systems) at un-repeated distances up to 10 kilometers (6.2 miles).

Configuration information

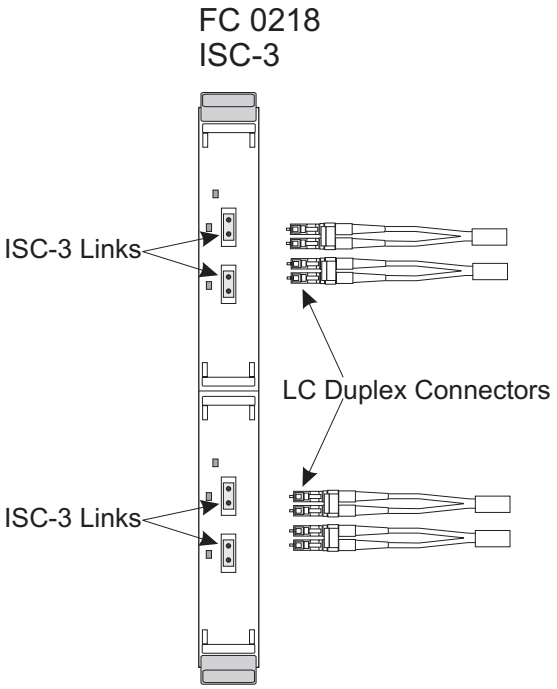
The table below describes the ISC-3 feature.

Feature Code	Description	Fiber type	Connector type
FC 0218	2-Port ISC-3	9 micron single mode	LC Duplex

- ISC-3 links are comprised of:
  - FC 0218 - A “daughter” adapter card with two ISC-3 ports per card.
  - FC 0217 - A “mother” card into which can be plugged two “daughter” cards.
  - FC 0219 - LMC that activates the ports on a “daughter” card. Each port on a “daughter” card is activated individually.
  - The “mother” card, two “daughter” cards, and the individual port LIC can combine to provide up to four ports per ISC-3 adapter.

    Note: On an initial system order, any request for more than two ISC-3 ports automatically generates a minimum of two FCs 0217. This ensures maximum ISC-3 availability and efficiency.
- The system configuration tool places the ISC-3 feature port LMC across an appropriate number of cards for high availability.
- See *System z Planning for Fiber Optic Links (ESCON, FICON, Coupling Links, and Open System Adapters)* for information about link distances and light loss budget.

The following illustration shows the ISC-3 feature, the links on the daughter cards, and the type of fiber optic connector that plugs into the transceivers.



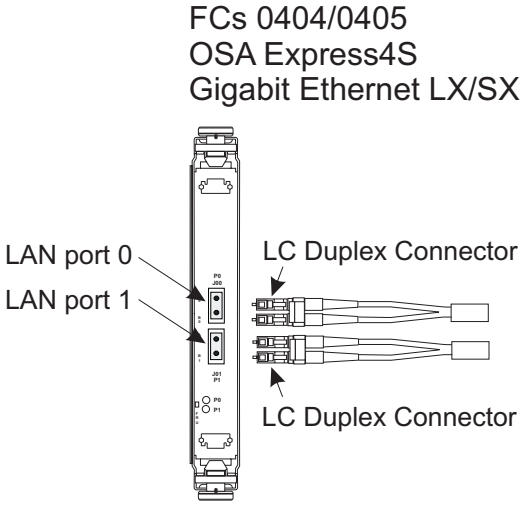
OSA-Express LAN features

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

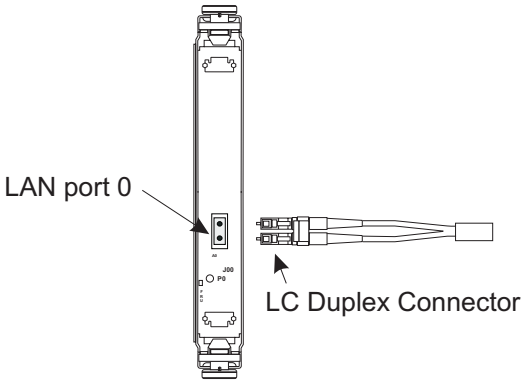
Configuration information

The table below lists the OSA-Express features.

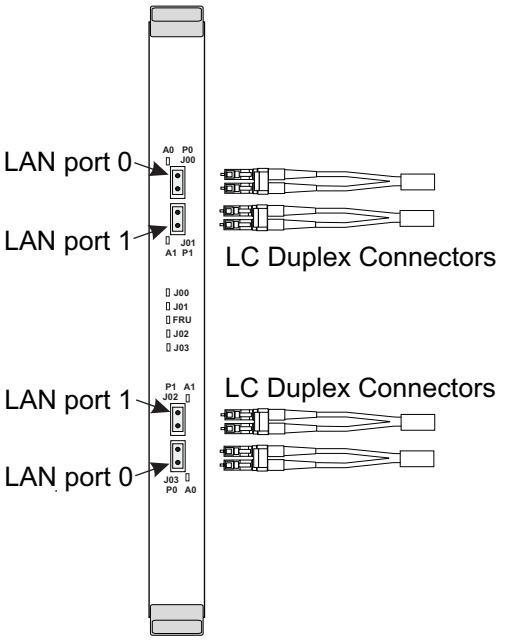
Feature Code	Feature Description	Cable Description	Connector Type
FC 0406 OSA-Express4S (PCIe)	1-Port LR 10 Gigabit Ethernet	9 micron single mode	LC Duplex
FC 0407 OSA-Express4S (PCIe)	1-Port SR 10 Gigabit Ethernet	50 and 62.5 micron multimode	LC Duplex
FC 0404 OSA-Express4S (PCIe)	2-Port LX Gigabit Ethernet	9 micron single mode	LC Duplex
FC 0405 OSA-Express4S (PCIe)	2-Port SX Gigabit Ethernet	50 and 62.5 micron multimode	LC Duplex
FC 3362 OSA-Express3	4-Port LX Gigabit Ethernet	9 micron single mode	LC Duplex
FC 3363 OSA-Express3	4-Port SX Gigabit Ethernet	50 and 62.5 micron multimode	LC Duplex
FC 3367 OSA-Express3	4-Port 1000 Base-T Ethernet	Category 5 UTP copper wire	RJ-45
FC 3370 OSA-Express3	2-Port LR 10 Gigabit Ethernet	9 micron single mode	LC Duplex
FC 3371 OSA-Express3	2-Port SR 10 Gigabit Ethernet	50 or 62.5 micron multimode	LC Duplex



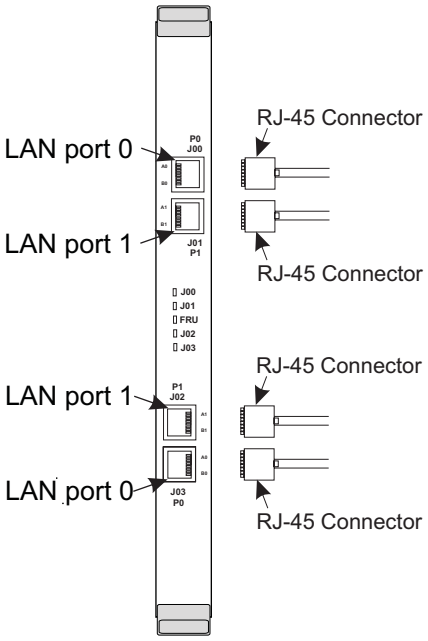
FCs 0406/0407
OSA Express4S
10 Gigabit Ethernet LR/SR



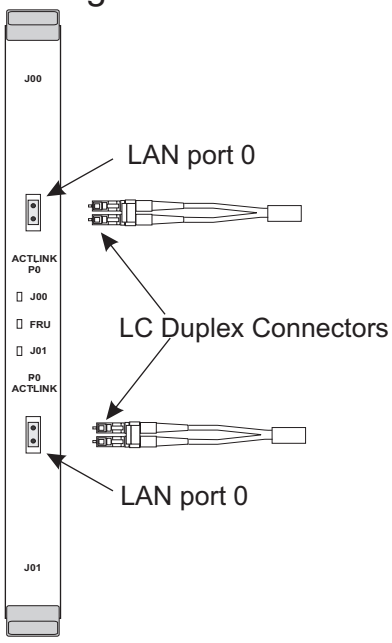
FCs 3362/3363 OSA-Express3 Gigabit Ethernet LX/SX



FC 3367 OSA Express3 1000Base-T Ethernet



FC 3370/3371 OSA-Express3 10 Gigabit Ethernet LR/SR



OSA-Express reference

For additional information on planning for OSA features, see:

- *System z Planning for Fiber Optic Links (ESCON, FICON, Coupling Links, and Open System Adapters)*, GA23-0367
- *Open System Adapter-Express Integrated Console Controller User's Guide* , SA22-7990
- *zEnterprise, System z10, System z9 and zSeries Open Systems Adapter-Express Customer's Guide and Reference*, SA22-7935.

Time synchronization

Synchronized time is possible with a z196 server in a Sysplex environment using Server Time Protocol (STP). STP supports Coordinated Timing Networks (CTNs) where the z196 servers in the network are configured to be in STP timing mode.

Server time protocol

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 ISC-3 or InfiniBand fiber optic cables to create the Sysplex. STP can be installed on z196, z114, z10 EC, z10 BC, z9 EC, z9 BC, z990, z890, and Coupling Facility servers. z900 and z800 servers cannot participate in a Sysplex with zEnterprise 196.

Pulse per second

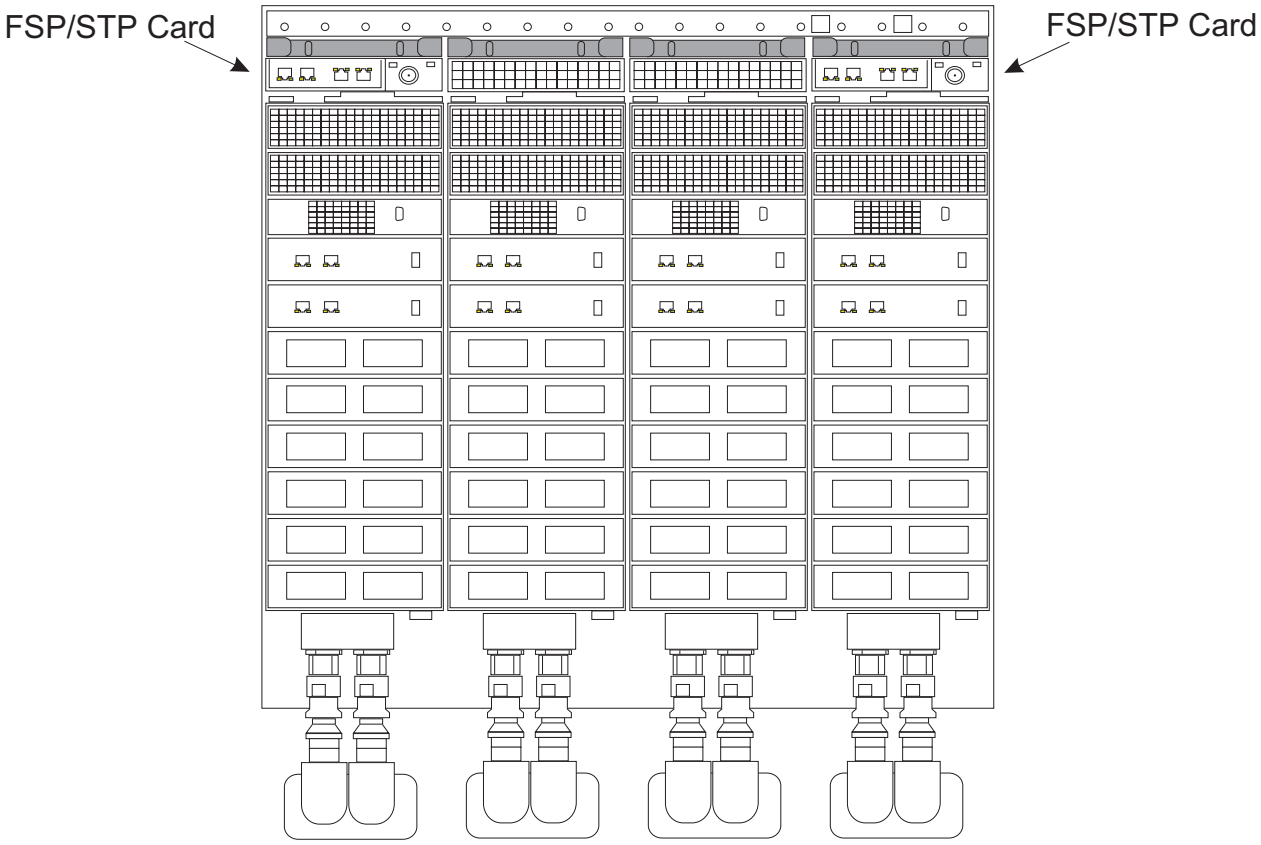
An STP CTN has the capability of configuring as its time source a Network Time Protocol (NTP) time server that has a pulse per second (PPS) output signal. This type of external time device is available worldwide from several vendors that provide network timing solutions. Typically, the NTP output of the time server is connected to the support element (SE) LAN, because the NTP client runs on the SE. The PPS output of the NTP time server is connected to the PPS input coaxial connector, provided on the FSP/STP card of the System zEnterprise 196. On System z10®, or System z9 servers, the PPS connector is on the ETR card. Note that pulse per second is only available for System zEnterprise 196, System z10, or System z9.

Connectivity information

The cable for pulse per second is coaxial. You are responsible for supplying these cables.

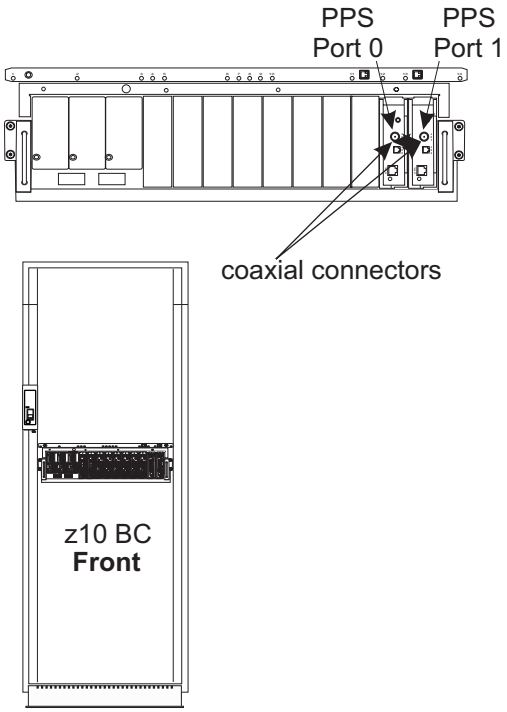
FSP/STP location

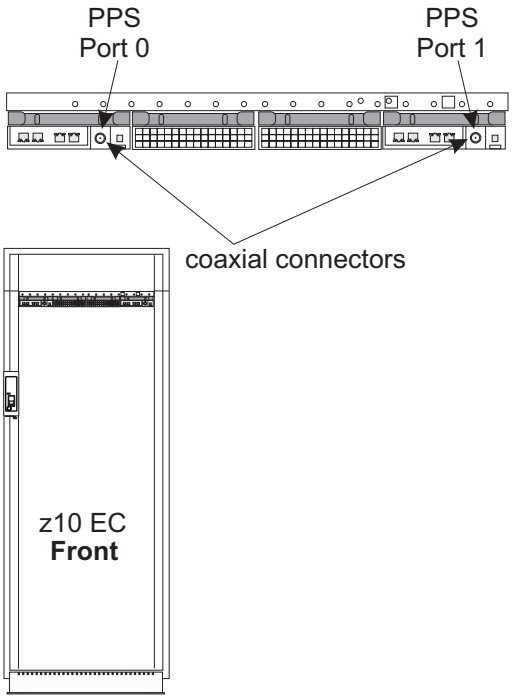
The following illustration shows the location of the FSP/STP cards in the z196 server.

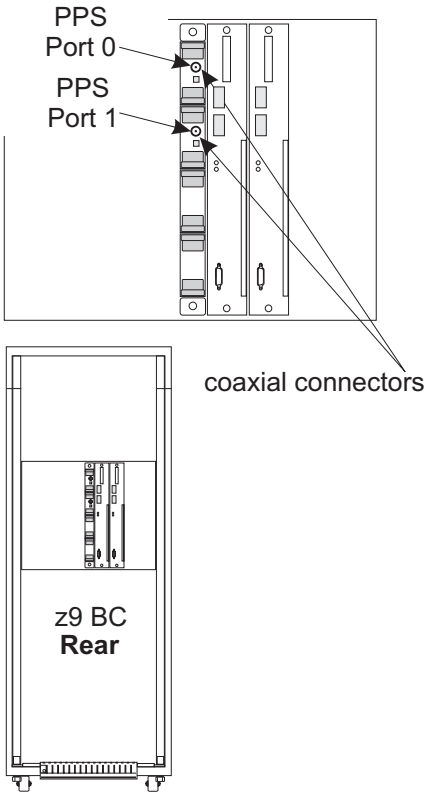


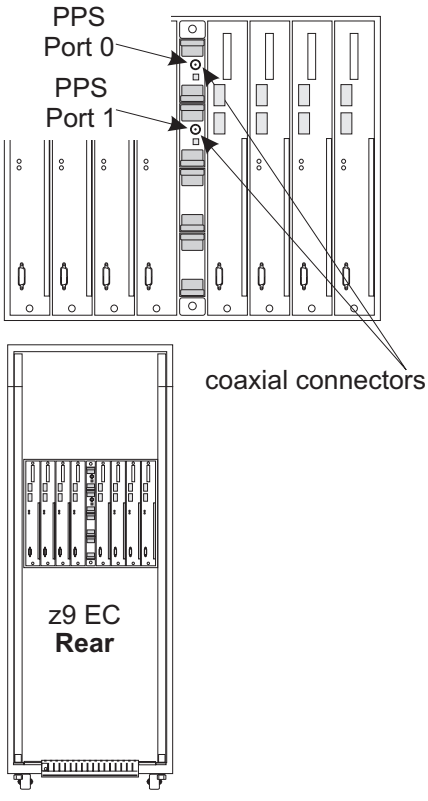
Ordering PPS cables

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 zEnterprise 196 to the NTP server providing the PPS signal. The illustration shows where the PPS cables are connected in the System z10 and System z9 servers.


PPS
Port 0
PPS
Port 1
coaxial connectors
z10 BC
Front


PPS
Port 0
PPS
Port 1
coaxial connectors
z10 EC
Front


PPS
Port 0
PPS
Port 1
coaxial connectors
z9 BC
Rear


PPS
Port 0
PPS
Port 1
coaxial connectors
z9 EC
Rear

InfiniBand fiber optic links

The HCA3-O feature (FC 0171) and HCA2–O feature (FC 0163) support 12x InfiniBand for coupling communication between systems. 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 fiber optic connection between z196 and z114 servers, and up to 3.0 GBps between z10 and z9 servers. A 12x InfiniBand fiber optic cable (50 micron multimode OM3) connects directly to an HCA3-O port or an HCA2-O port on a z196 or z114 fanout card.

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

Table 31. InfiniBand cable part numbers for FCs 0163, and 0171 on System z servers

Part Number	Length-Meters	Length-Feet
41V2466	10.0 m	32.8 ft
15R8844	13.0 m	42.7 ft
15R8845	15.0 m	49.2 ft
41V2467	20.0 m	65.6 ft
41V2468	40.0 m	131.2 ft
41V2469	80.0 m	262.4 ft
41V2470	120.0 m	393.7 ft
41V2471	150.0 m	492.1 ft
42V2083	Custom	Custom

The HCA3-O LR feature (FC 0170) and the HCA2-O LR feature (FC 0168) support 1x Long Reach (LR) InfiniBand and provides up to a 5.0 Gbps fiber optic connection between z196 or z114 servers.

A 1x LR InfiniBand fiber optic cable (9 micron single mode) connects directly to an HCA2-O LR port on a fanout card on a z196 or z114 server.

Notes:

1. InfiniBand will not connect to z990 or z890.
2. You must supply InfiniBand cables as you do with other fiber optic systems (FICON, ESCON, OSA).

Feature Code	Description	Fiber Type	Connector Type
FC 0171	HCA3-O	SX laser 50 micron	MPO
FC 0163	HCA2–O	SX laser 50 micron	MPO
FC 0170	HCA3-O LR	9 micron single mode	LC Duplex
FC 0168	HCA2-O-LR	9 micron single mode	LC Duplex

Fiber quick connect ESCON and FICON cabling

Fiber Quick Connect harness cabling, harness brackets and mounting hardware are ordered with the zEnterprise 196 server as feature codes. The feature codes are:

Table 32. Fiber Quick Connect Feature Codes

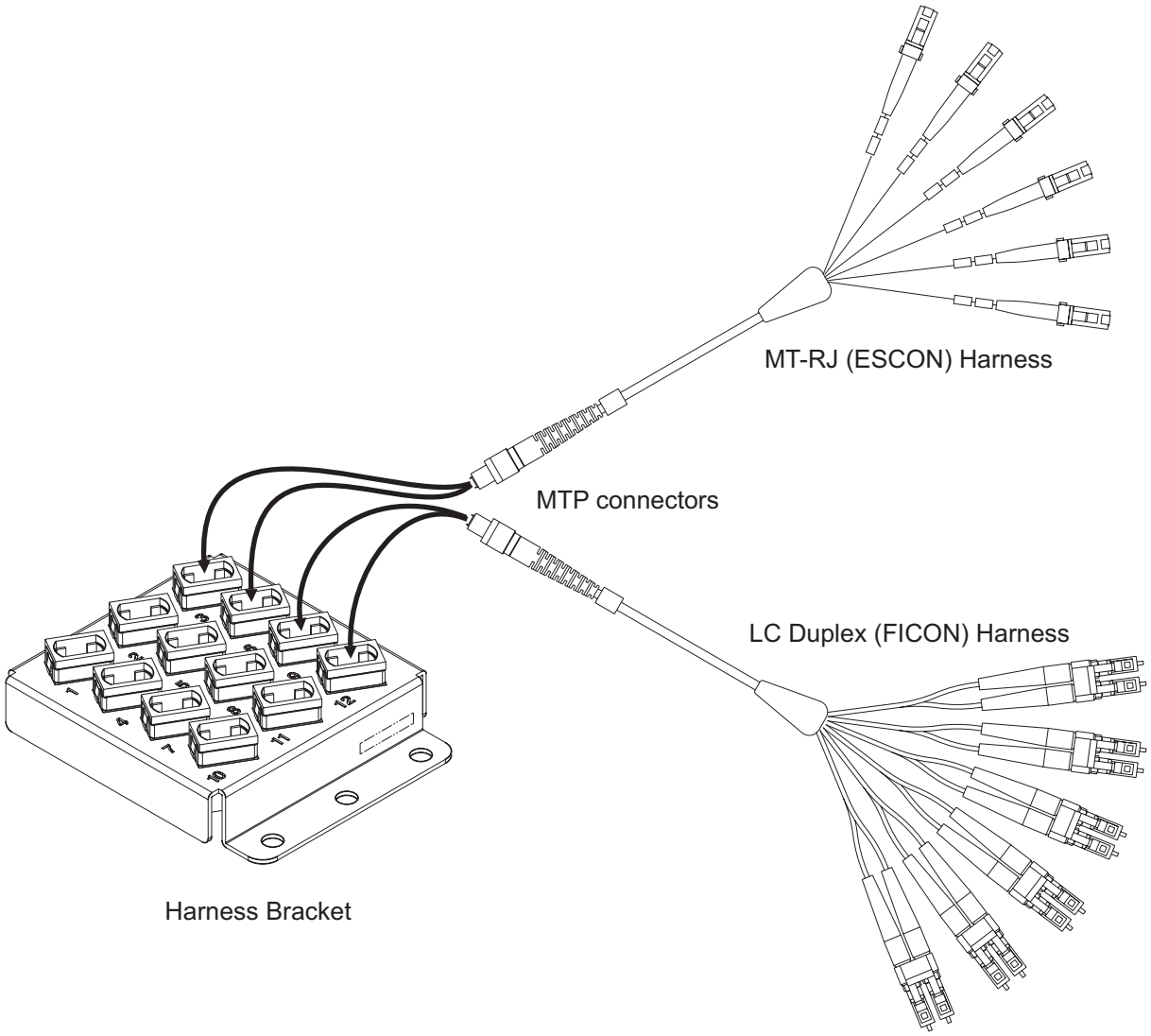
Fiber Quick Connect (FQC) Feature Codes - Air-cooled		
7900	FQC first bracket and mounting hardware (Air-cooled)	base clamp and bracket
7902	MT-RJ 6 ft. harness (ESCON) (Air-cooled)	from cages at A01 or Z01or drawers at Z15 or Z22
7903	MT-RJ 8.5 ft. harness (ESCON) (Air-cooled)	from a cage at Z15
7904	MT-RJ 5 ft. harness (ESCON) (Air-cooled)	from drawers at A08 or Z08
7905	MT-RJ 3.5 ft. harness (ESCON) (Air-cooled)	from drawers at A01 or Z01
7906	LC Duplex 6.6 ft. harness (FICON) (Air-cooled)	from cages at A01 or Z01or drawers at A01, A08, Z01, Z08, Z15, or Z22
7908	LC Duplex 8.5 ft. harness (FICON) (Air-cooled)	from cage at Z15 or a drawer at A08
Fiber Quick Connect (FQC) Feature Codes - Water-cooled		
7910	FQC first bracket and mounting hardware (Water-cooled)	base clamp and bracket
7912	MT-RJ 6 ft. harness (ESCON) (Water-cooled)	from a cage Z01or drawers at A15, Z15, or Z22
7913	MT-RJ 8.5 ft. harness (ESCON) (Water-cooled)	from a cage A08 or Z15
7914	MT-RJ 5 ft. harness (ESCON) (Water-cooled)	from drawers at A08 or Z08
7915	MT-RJ 3.5 ft. harness (ESCON) (Water-cooled)	from a drawer at Z01
7916	LC Duplex 6.6 ft. harness (FICON) (Water-cooled)	from cages at A01 or Z01or drawers at A01, A08, Z01, Z08, Z15, or Z22
7918	LC Duplex 8.5 ft. harness (FICON) (Water-cooled)	from cage at Z15

The Fiber Quick Connect feature enables trunk cables to connect to FICON or ESCON channels using under-the-cover attachment harnesses. These harnesses are installed when your system is built, and your zEnterprise 196 arrives ready to connect the trunk cables at your site.

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

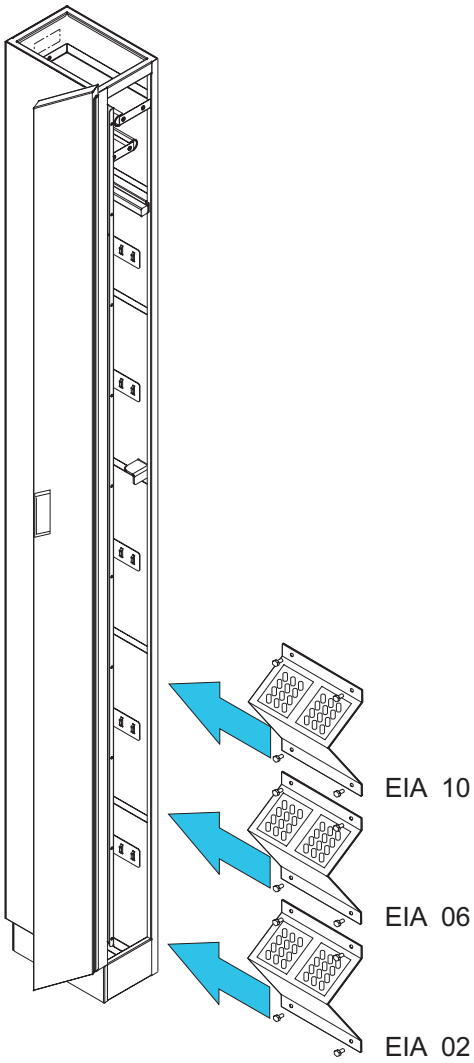
- A-frame front - A00L (1), A00K (2), A00J (3), A00G (4)
- A-frame rear - A00N (1), A00P (2), A00Q (3)
  1. For a water cooled machine, due to space limitations, the quantity of rear brackets is limited to two, A00N and A00P.
  2. For a water cooled machine if the amount of I/O in the order would require more than two A frame rear brackets then the configuration will not be allowed and a message will be generated to inform you that the order cannot be completed as configured.
- Z-frame front - Z00B (1), Z00C (2), Z00E (3), Z00F (4), Z00G (5)
- Z-frame rear - Z00Y (1), Z00X (2), Z00W (3), Z00U (4)

This illustration shows the Fiber Quick Connect feature hardware.



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

Fiber Quick Connect mounting brackets can also be installed at EIA positions 02, 06, and 10 in the I/O top exit cabinets.



If you are planning to use the Fiber Quick Connect feature for FICON or ESCON 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 definition

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.

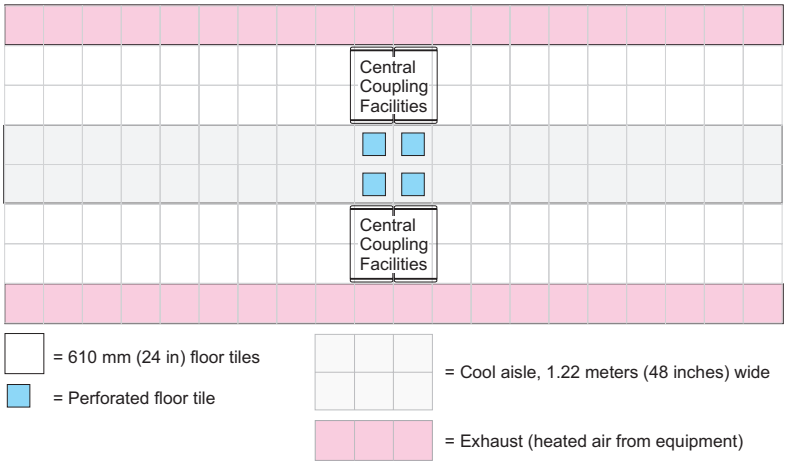
If you are installing a new processor, instead of using a diskette you can remotely write the IOCDS from an HCD that is running on an installed CPC in the same HMC cluster. Inform the install team that plans are in place to use the "Build and manage S/390 microprocessor IOCDSs" option in HCD to write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

Chapter 9. Parallel sysplex

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 91. Different technologies for servers, links and coupling facilities affect your ability to configure a productive sysplex. Following are some guidelines to help you better plan for multiple system interconnection.

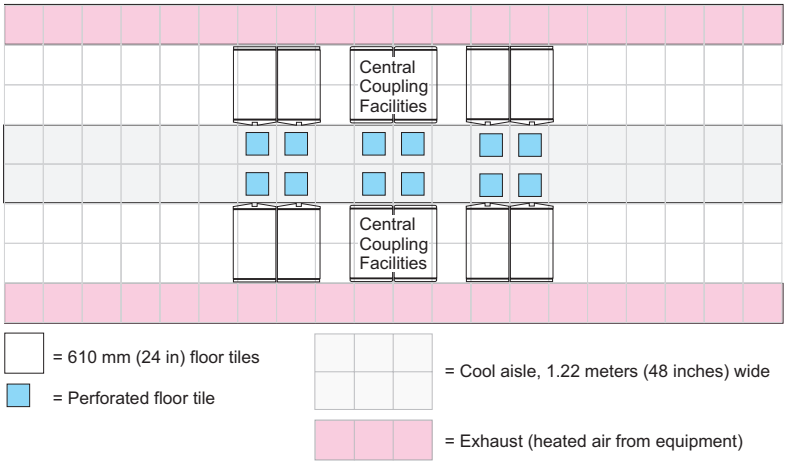
The basic premise for a successful Parallel Sysplex installation is to centralize the physical location of the coupling facilities, and then position the sysplex servers around that center.

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 39). Allow a 1.22 meter (48 inch) 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 the illustration under "Cooling recommendations for the room" on page 43).

   Note: The system air flow illustration shows a minimum aisle width of 941 mm (37 in). Although this width is adequate for a congested computer room floor, it is the **minimum** you should use. An aisle 1.22 m (48 in) wide will better serve the cooling and cabling needs of a Parallel Sysplex configuration.



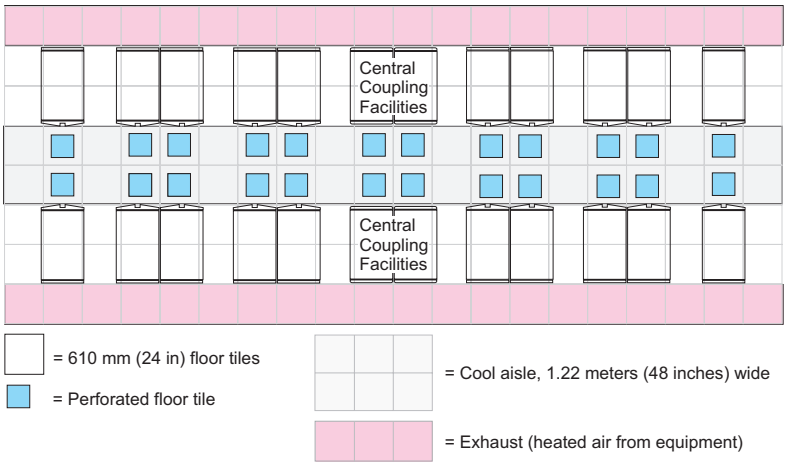
3. Sysplex connections for zEnterprise 196 will be made using ISC-3 and InfiniBand fiber optic link cabling. The Sysplex itself may be comprised of servers connected through an ECF/ETR feature to a Sysplex Timer, servers connected to each other through the Server Time Protocol feature (STP), or a mixture of both types of connections. zEnterprise 196 servers can communicate directly in a Sysplex environment only with zEnterprise 114, z10 EC, z10 BC, z9 EC, and z9 BC and only through STP.

   Note:

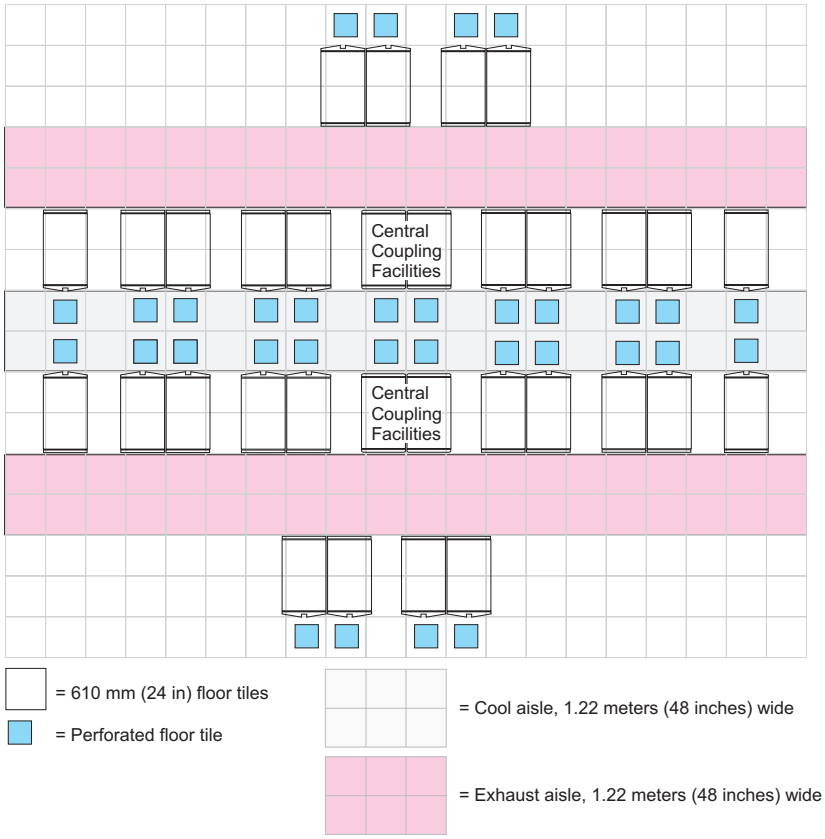
   a. zEnterprise 196 has no External Time Reference (ETR) capability.

   b. zSeries 990, zSeries 890, zSeries 900, and zSeries 800 can not participate in a Parallel Sysplex with the zEnterprise 196.

4. As the Parallel Sysplex grows, add new servers evenly on either side of the central coupling facilities.



5. As the Parallel Sysplex evolves, you may add rows using ISC links or InfiniBand links, which provide connectivity over greater distances 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 - zEnterprise, System z10, and System z9, 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

In Plan Views:

Cable Entry and Exit Area in the base of the machine. Locating dimensions are measured from the edge of the frame, not the cover. This does not indicate the floor cutout.

Cable Exit Area, recommended

Power Cord exit, 50/60 Hz

Power Cord exit, 400 Hz

Power cords are supplied in 4.2 m (14 ft) lengths unless otherwise noted on the specification page. The length is measured from the symbol ⊕ or ◕.

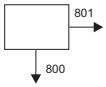
Swinging Gate

Standard equipment outline
(shows the machine with covers closed)

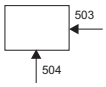
Optional equipment outline

Customer Engineer
Indicator Panel

In Cabling Schematics:



Indicates a cable group coming from a machine



Indicates a cable group going to a machine

Service Area Boundary
(Service clearances are measured from the machine with covers closed)

Casters
Locating dimensions are measured from the edge of the frame, not the cover.

Leveling pads or glides
(90 mm [3 1/2 in] typical diameter)
Locating dimensions are measured from the edge of the frame, not the cover.

Legs

Non-raised floor cable exit

Meter location

Unit Emergency Switch

Hinged Covers

Single

Bifold

Offset Bifold

Appendix B. Hardware Management Console physical specifications

Note: This appendix will contain 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.

FC 0084/0090/0091 - Hardware Management Console System Unit

Dimensions	
Height	438 mm (17.3 in.)
Width	216 mm (8.5 in.)
Depth	540 mm (21.3 in.)
Weight minimum configuration as shipped	16.3 kg (36 lbs.)
Weight maximum configuration	25.2 kg (56 lbs.)
Input Power[1]	
Voltage switch setting 115 Vac	
Low range input voltage	100 Vac - 127 Vac
Input frequency range	47 - 53 Hz
Voltage switch setting 230 Vac	
High range input voltage	200 Vac - 240 Vac
Input frequency range	57 - 63 Hz
Input kilovolt-amperes (kVA) (approximate)	
Minimum configuration as shipped	0.20 kVA
Maximum configuration	0.55 kVA
Output power[1]	
Heat output in British thermal units (Btu) (approximate)	
Minimum configuration	630 Btu/hr (185 watts)
Maximum configuration	1784 Btu/hr (523 watts)
Environmentals	
Server On - 0 to 914 m (2998 ft)	10° to 35° C (50° to 95° F)
Server On - 914 m (2998 ft) to 2133.6 m (7000 ft)	10° to 32° C (50° to 89.6° F)
Server Off - to 2133 m (7000 ft)	10° to 43° C (50° to 109.4° F)
Shipping	-40° to 60° C (-40° to 140° F)
Humidity range (operating and storage)	8% - 80%
Note: Power consumption and heat output vary with the number and type of optional features installed and the power-management optional features in use.	

Note: When planning the work area for the Hardware Management Console, remember to allow a suitable space for a full-size keyboard and mouse.

FC 6096 - flat panel display 558.7 mm (22.0 inch) TFT LCD

Dimensions	
Height	406.0 mm (15.98 in.)
Width	514.4 mm (20.25 in.)
Depth	239.8 mm (9.44 in.)
Weight with stand	6.2 kg (20.5 lbs)
Input power	
Input voltage	100 Vac - 240 Vac (+/- 10%)
Input frequency range	50/60 Hz + or - 3 Hz
Rated Current	1.5 Amps
Power consumption	
Normal operation:	< 45 watts
Standby/Suspend:	< 2 watts (analog or digital)
Active off:	< 1 watt (at 100 VAC and 240 VAC)
Environmentals	
Temperature	
Operating	10° to 45° C (50° to 113° F)
Storage	-20° to 60° C (-4° to 140° F)
Shipping	-20° to 60° C (-4° to 140° F)
Humidity	
Operating	10% to 80%
Storage	5% to 90%
Shipping	5% to 90%

Note: When planning the work area for the Hardware Management Console, remember to allow a suitable space for a full-size keyboard and mouse.

Appendix C. Acoustics

This appendix provides information on acoustics for the zEnterprise 196 at nominal environmental ambient temperatures of 23ºC plus or minus 2ºC (73.4ºF plus or minus 3.6ºF).

Acoustical noise emission levels

Product configuration	Declared A-weighted sound power level $L_{WAd\ (B)}$		Declared A-weighted sound pressure level $L_{pAm\ (dB)}$	
	Operating (B)	Idling (B)	Operating (dB)	Idling (dB)
Typical Configuration: MT 2817 Model M32 MRU-system installed with one I/O cage and one I/O drawer. All air-moving devices at nominal speeds; front and rear acoustical doors.	7.8(4)	7.7(4)	59	59
Maximum Configuration: MT 2817 Model M80 MRU-system installed with two I/O cages and two I/O drawers. All air-moving devices at nominal speeds; front and rear acoustical doors.	8.0(5)	8.0(5)	62	62
Typical Configuration: MT 2817 Model M32 MWU-system installed with one I/O cage and one I/O drawer. All air-moving devices at nominal speeds; front and rear acoustical doors.	7.8(4)	7.8(4)	59	59
Maximum Configuration: MT 2817 Model M80 MWU-system installed with two I/O cages and two I/O drawers. All air-moving devices at nominal speeds; front and rear acoustical doors.	7.9(4)	7.9(4)	61	61

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. 1B = 10dB.
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.

Relevant international standards:

- Measurements: ISO 7779
- Declaration: ISO 9296

Appendix D. 3-phase dual power installation

The zEnterprise 196 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 distribution panels.

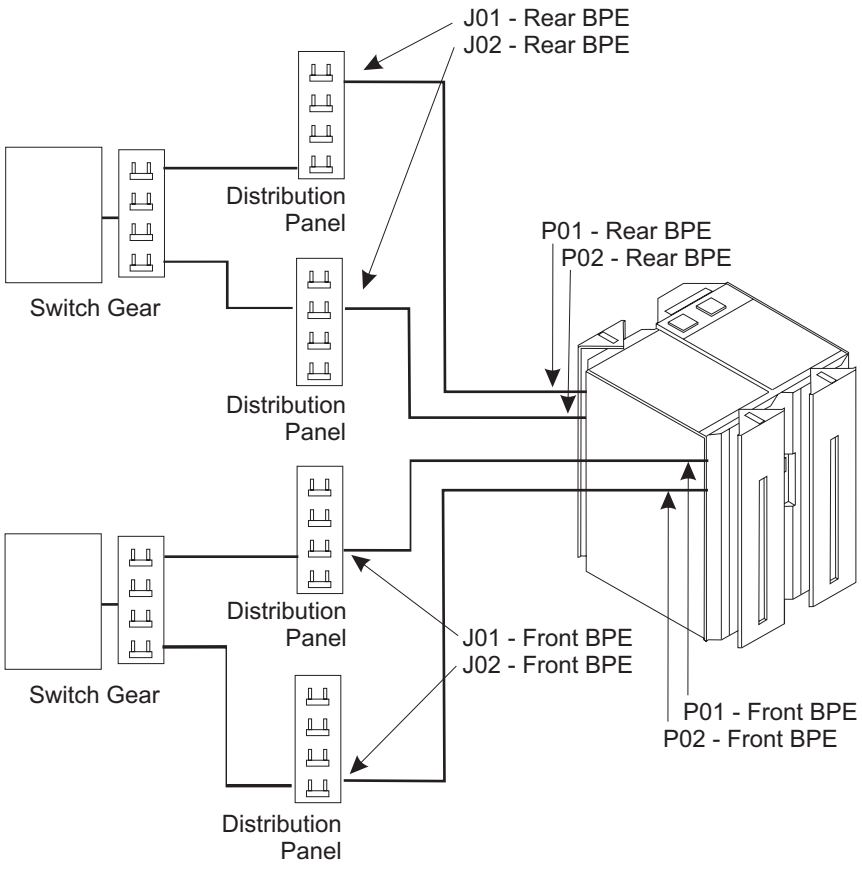
The following shows four examples of redundancy. In these examples, up to four power cords are identified.

- **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.

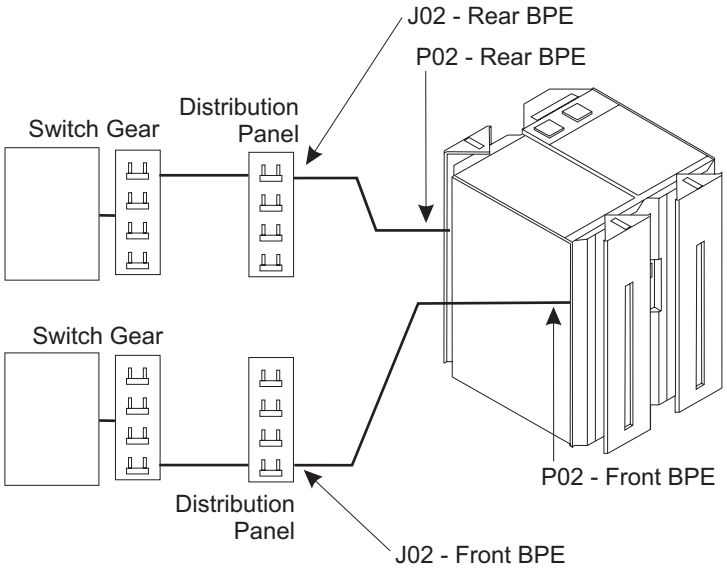
This type of power distribution will not result in system outage in the event of a power failure at either switch gear or one of the distribution panels. IBM recommends this power distribution to achieve highest availability.

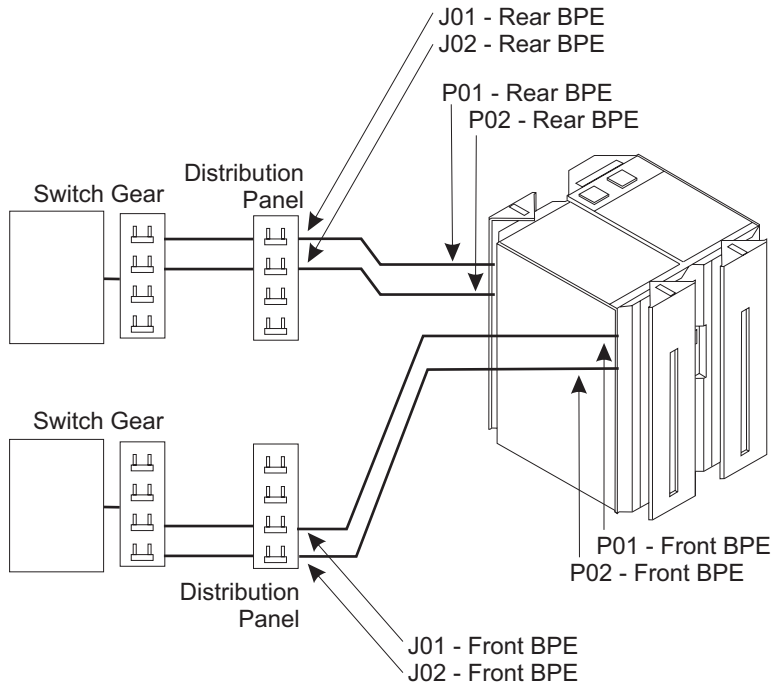


Example 2 (redundant distribution panel and switch gear)

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.

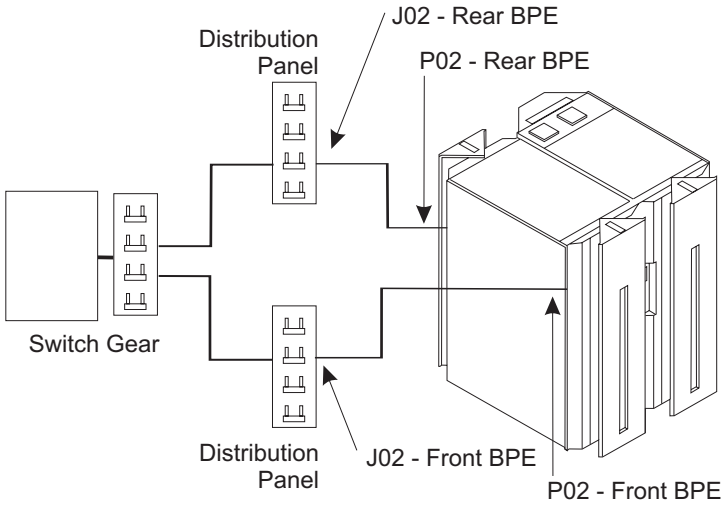
This type of power distribution will not result in system outage in the event of a power failure at either switch gear or either distribution panels.

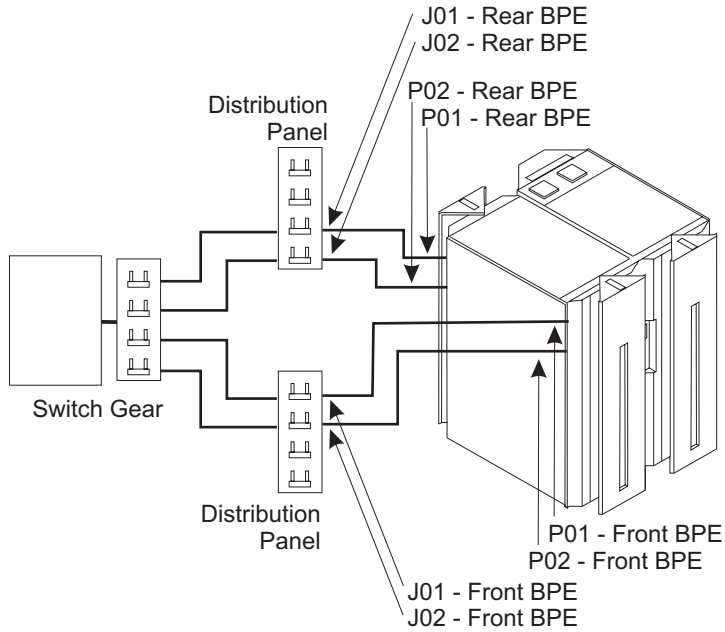




Example 3 (redundant distribution panel)

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.

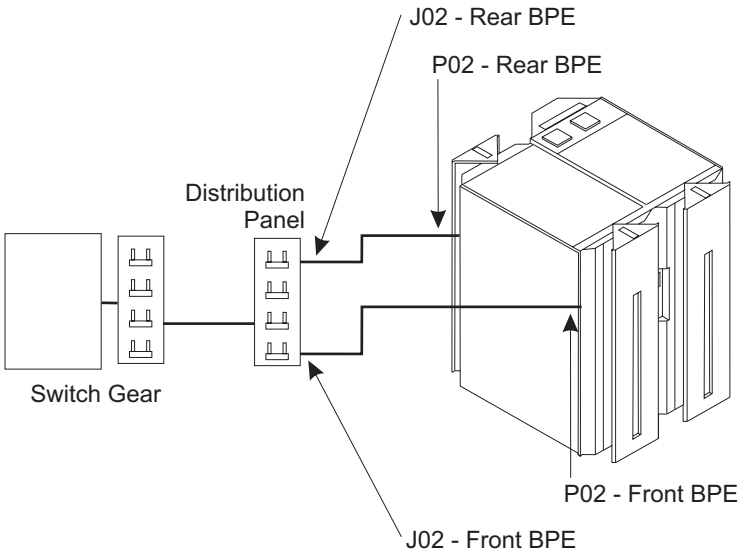


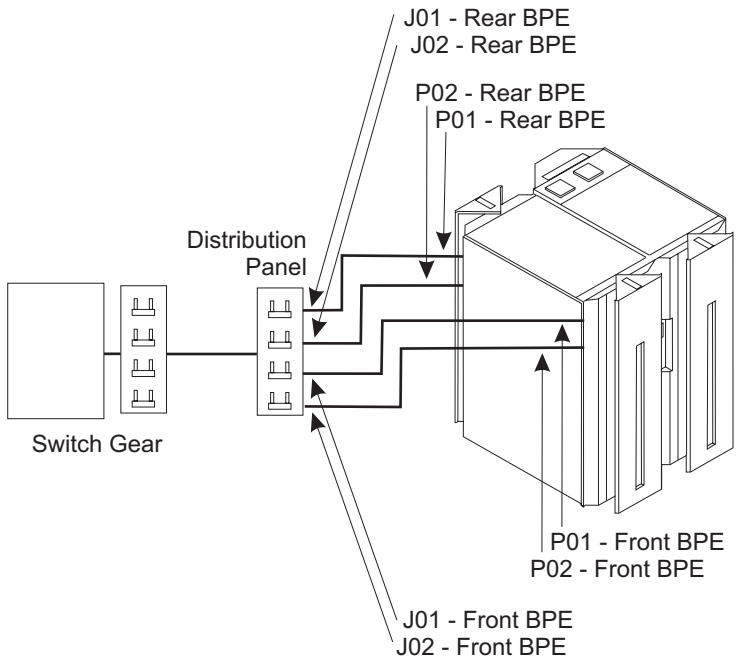


Example 4 (single distribution panel)

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 E. Balancing power panel loads

The zEnterprise 196 models require three phase power. Depending on the system configuration, the phase currents can be fully balanced or unbalanced. For each possible cage 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 4 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.

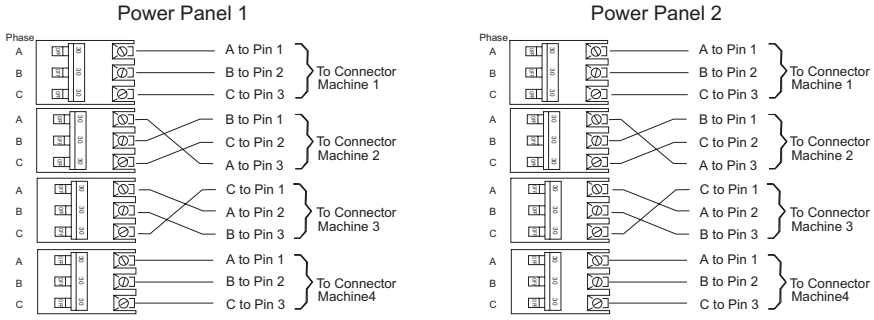


Figure 4. Power load balancing - three-pole breakers

The method in Figure 4 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 5 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.

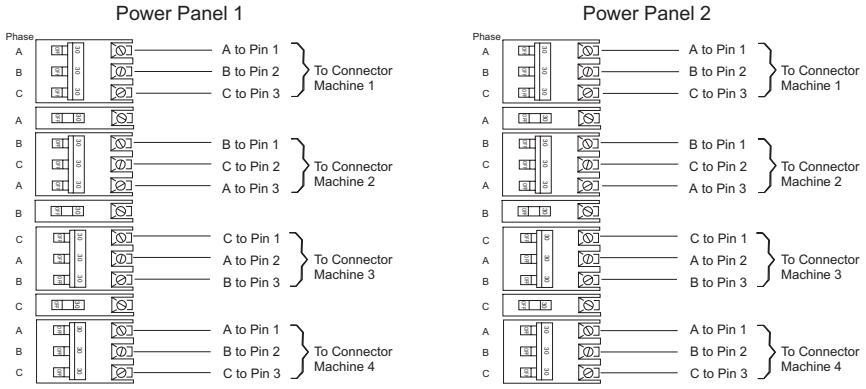


Figure 5. Power load balancing - alternating three-pole and single-pole breakers

Figure 6 shows another way of distributing the unbalanced load evenly. In this case, the three-pole breakers are alternated with two-pole breakers.

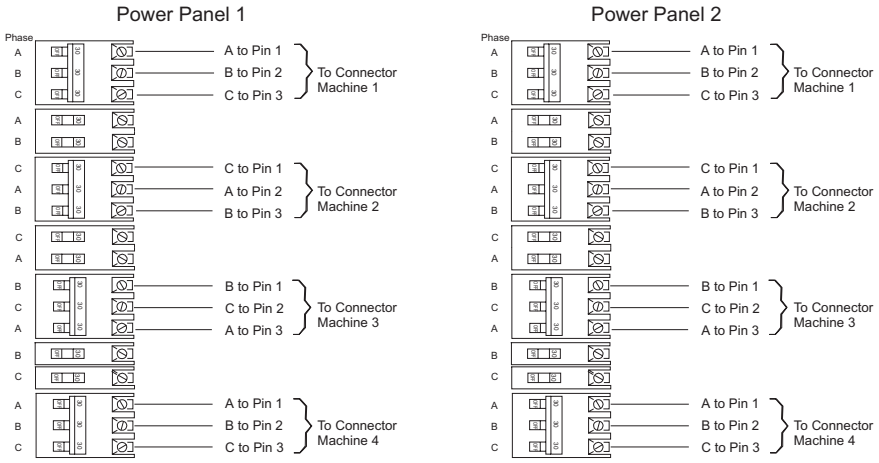


Figure 6. Power load balancing - alternating three-pole and double-pole breakers

Appendix F. Frame tie-down

The purpose of this installation instruction is to install a frame tie down kit that will provide frame ruggedizing and the floor tie down hardware for securing an IBM frame to a concrete floor beneath a 9" to 36" raised floor. This 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.

Frame tie-down for the zEnterprise 196 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. This appendix describes the installation of the eyebolts.

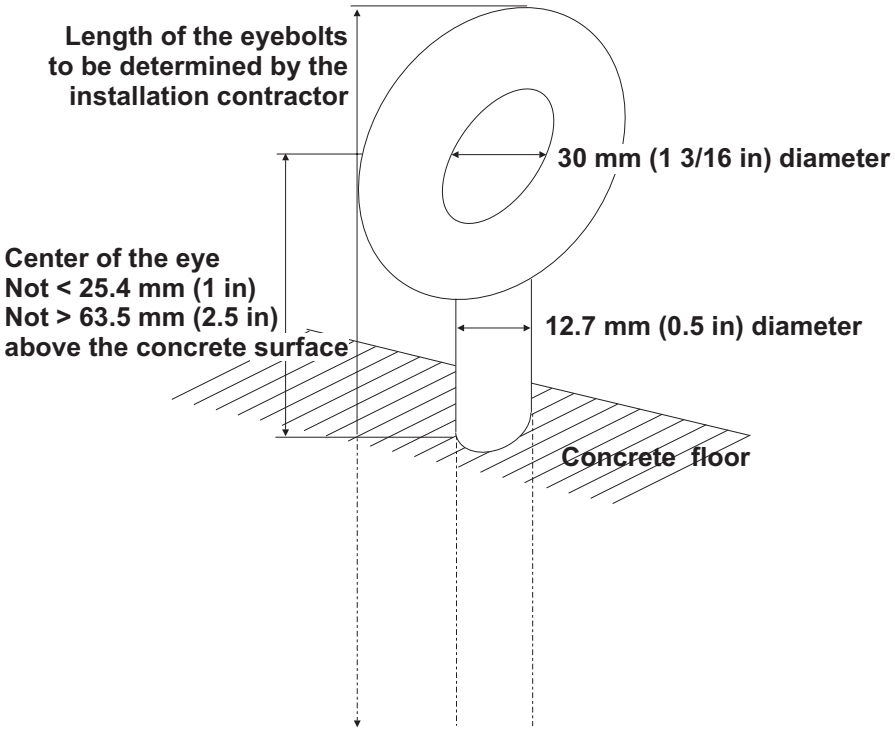
You are responsible for obtaining the services of a qualified consultant or structural engineer to determine what must be done at your particular location to install **four eyebolts per frame** capable of withstanding a pull force of 975.2 kg (2150 lbs) **each**.

Depending on the amount of space between your raised floor panels and the concrete floor beneath it, you will need to order either Feature Code 8008 (for air-cooled machines) or Feature Code 8009 (for water-cooled machines). Remember, because the z196 is always a two-frame server, you must order **two FCs** for each server you intend to secure.

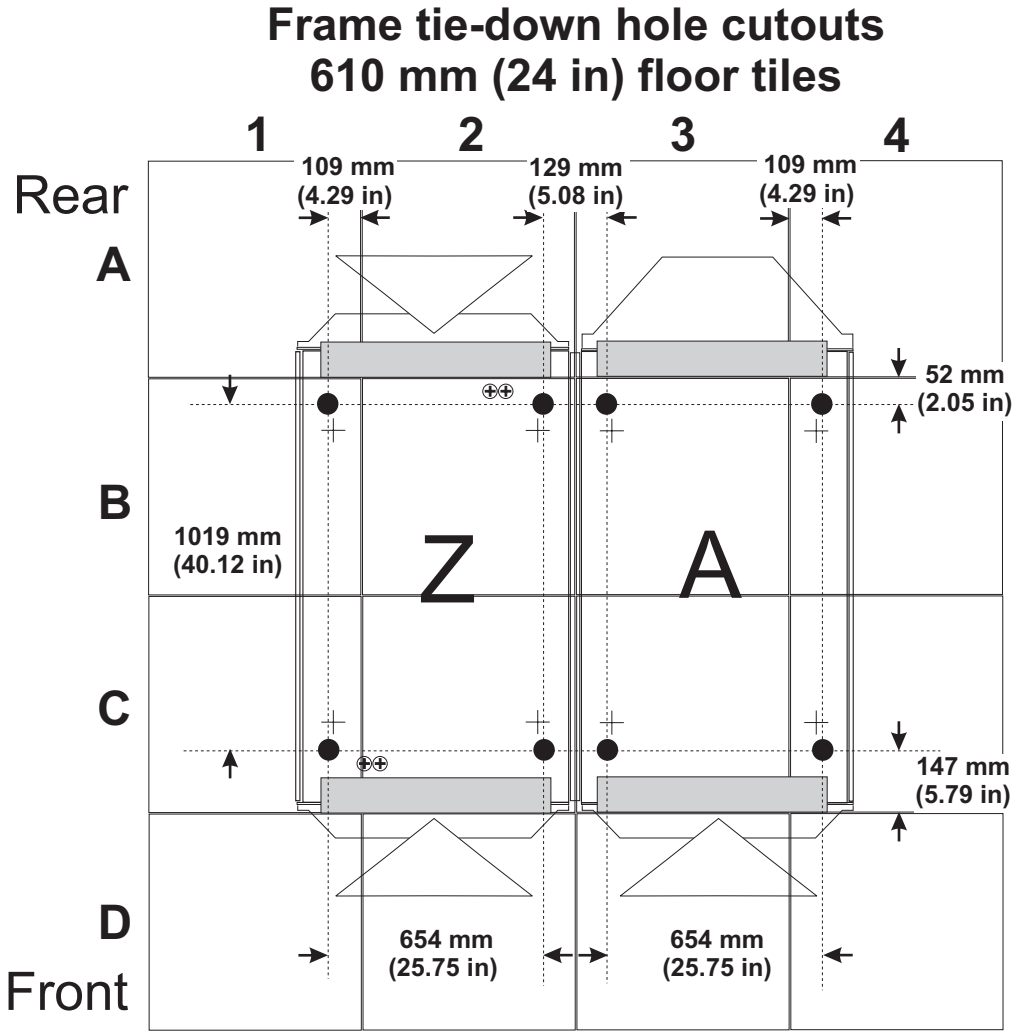
Installing the eyebolts

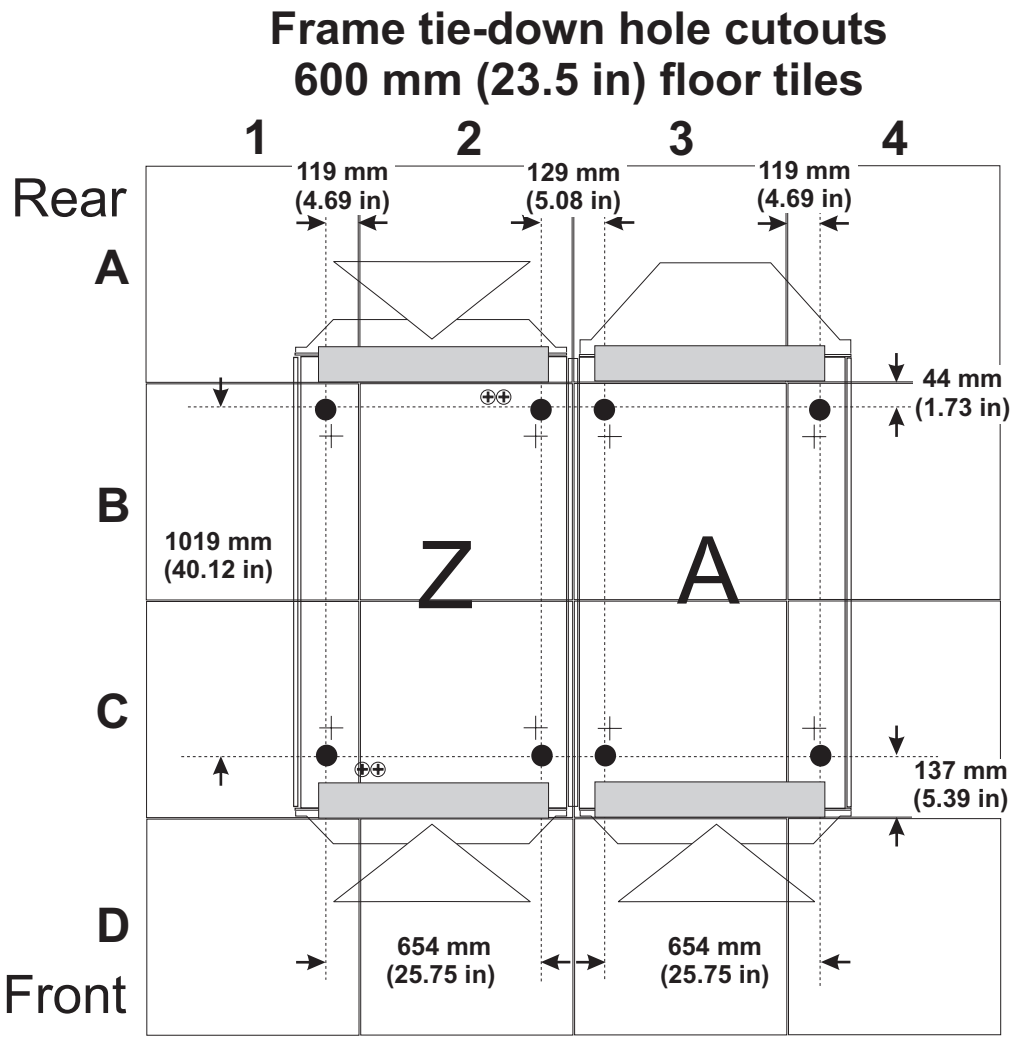
You are responsible for obtaining and installing the eyebolts that will anchor the frames of your zEnterprise 196 server. Following are the specifications for the eyebolts:

- 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.
- Able to withstand a pull force of 975.2 kg (2150 lbs)



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





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 four 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 *zEnterprise 196 Installation Manual* shipped with the server.

Appendix G. Modem support information

Ordering telecommunication service

The following section describes the telephone line and modem requirements for the Hardware Management Console Remote Support Facility (RSF).

It is the customer's responsibility to arrange for installation and all costs of common-carrier equipment.

Each Hardware Management Console (HMC) comes with a modem. One telephone line is required for **each** modem installed.

Note: It is recommended that CPCs be assigned to more than one Hardware Management Console phone server.

When ordering telecommunications service, be prepared to identify the following:

- The type of telephone jack required (country dependent)
- The long distance carrier
- The selection of either dual tone multi-frequency (DTMF) or rotary (pulse) to be installed
- Installer of the telephone wiring and jack

The telephone line must be a dial-up (public switched network) analog type* with 24-hour, 7-day-a-week availability.

Note: *Digital telephone lines must not be used.

Modems

All models require a modem for telephone-based RSF. The modem supplied by manufacturing is dependent on the destination country homologation requirements. Many geographies will receive an internal modem (Machine Type 9234ZPX) with a Hardware Management Console FC 0091, while some countries will continue to receive an external modem. The general specifications of the supported modem are:

Internal Modem - M/T 9234ZPX

- Data rate:
  - For V.92 servers and V90/K56flex servers - 56K bps download speed
  - For V.92 servers - 48K bps upload speed
  - 33.6 K bps transfer speed with other servers
- Standards:
  - Data: V.92, V.90, enhanced V.34 & below
  - Error Correction: V.42, ECM
  - Data Compression: V.44, V.42bis, MNP® Class 5
  - Fax: V.34, Class 2.1 & Class 1.0, V.17, Group 3, Class 1 & Class 2, Error Correction Mode (ECM)
  - Video: V.80
- Bus Type
  - 3.3V & 5V Universal PCI or PCI Express (x1)
- Connectors

  - 2 RJ-11s; speaker jack & microphone jack (voice models)
- Country dependent telecommunication cable: 4.6 m (15 ft.)
- Operating temperature: -5° to +60° C (+23° to +140° F)
- Operating relative humidity: 20-90% (no condensation)
- Weight: .94 g (3.3 lb)
- Physical Description:
  - Length: 153 mm (6.03 in)
  - Width: 121 mm (4.76 in)
- Certifications:
  - CE Mark
  - EMC: FCC Part 15 Class B, ICES-003 Class B, EN 55022 Class B, EN 55024
  - Safety: UL/cUL 60950-1, EN 60950-1, AS/NZS 60950:2000, CCC
  - Telecom: 47CFR Part 68, CS03, TBR21
  - Other countries also included

Important:

In countries where the IBM Hardware Management Console modem is not approved by the national communication authority a modem is needed which is in accordance with CCITT standard V.26bis. For non-IBM modems a 7852 equivalent, country-approved modem is required that meets the following specifications:

- Line speed - 9600 bps or greater
- Command set - AT command set for Asynchronous
- Mode - Asynchronous
- Connection - Switched public network

It is the responsibility of the country to approve a local modem in these cases using local procedures.

Appendix H. Notices

This information was developed for products and services offered in the USA.

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Electronic emission notices

The following statements apply to this IBM product. The statement for other IBM products intended for use with this product will appear in their accompanying manuals.

Federal Communications Commission (FCC) Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions contained in the installation manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, by installation or use of this equipment other than as specified in the installation manual, or by any other unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Canadian Department of Communications Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformlté aux normes du ministère des Communications du Canada

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

European Union (EU) Electromagnetic Compatibility Directive

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to European Standard EN 55022. The limits for Class equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Warning: This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

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Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Telephone: 0049 (0) 7032 15-2941
email: lugi@de.ibm.com

EC Declaration of Conformity (In German)

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 89/336/EWG zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der IBM gesteckt/eingebaut werden.

EN 55022 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:

"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem “Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)“. Dies ist die Umsetzung der EU-Richtlinie 89/336/EWG in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) vom 18. September 1998 (bzw. der EMC EG Richtlinie 89/336) für Geräte der Klasse A.

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Konformitätserklärung nach Paragraf 5 des EMVG ist die IBM Deutschland GmbH, 70548 Stuttgart.

Informationen in Hinsicht EMVG Paragraf 4 Abs. (1) 4:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

update: 2004/12/07

People's Republic of China Class A Compliance Statement

This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may need to perform practical actions.

声　明

此为A级产品，在生活环境中，
该产品可能会造成无线电干扰。
在这种情况下，可能需要用户对其
干扰采取切实可行的措施。

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