

# Site Preparation Guide

**HP 9000 rp4410 and HP 9000 rp4440**



**Manufacturing Part Number: A9950-96004**

**Third Edition**

**April 2005**

U.S.A.

© Copyright 2004-2005 Hewlett-Packard Development Company, L.P.

---

## Legal Notices

**Copyright Notices.** © Copyright 2004-2005 Hewlett-Packard Development Company, L.P.

The information contained herein is subject to change without notice.

The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

**1. System Specifications**

System Configuration . . . . .	11
Dimensions and Weights . . . . .	13
Component Dimensions . . . . .	13
Grounding . . . . .	14
Electrical Specifications . . . . .	15
AC Power Cords . . . . .	15
Circuit Breaker . . . . .	15
System Power Specifications . . . . .	16
Power and Cooling . . . . .	17
Environmental Specifications . . . . .	19
Temperature and Humidity . . . . .	19
Operating Environment . . . . .	19
Environmental Temperature Sensor . . . . .	19
Nonoperating Environment . . . . .	19
Cooling . . . . .	19
Acoustic Noise Specification . . . . .	21

**2. General Site Preparation Guidelines**

Electrical Factors . . . . .	23
Computer Room Safety . . . . .	23
Power Consumption . . . . .	24
Electrical Load Requirements (Circuit Breaker Sizing) . . . . .	24
Power Quality . . . . .	24
Distribution Hardware . . . . .	25
Grounding Systems . . . . .	26
System Installation Guidelines . . . . .	29
Environmental Elements . . . . .	30
Computer Room Preparation . . . . .	30
Cooling Requirements . . . . .	30
Humidity Level (RH) . . . . .	32
Dust and Pollution Control . . . . .	32
Metallic Particulate Contamination . . . . .	33
Electrostatic Discharge (ESD) Prevention . . . . .	34
Acoustics . . . . .	34
Facility Characteristics . . . . .	35
Floor Loading . . . . .	35
Windows . . . . .	37
Space Requirements . . . . .	38
Delivery Space Requirements . . . . .	38
Operational Space Requirements . . . . .	38
Floor Plan Grid . . . . .	38
Conversion Factors and Formulas . . . . .	40
Conversion Factors . . . . .	40
Formulas . . . . .	40
Sample of an Installation Schedule . . . . .	41

---

# Contents

Sample Site Inspection Checklist .....	42
Delivery Survey .....	45
Information to Collect Before You Contact Support.....	47
<b>Glossary .....</b>	<b>49</b>
<b>Index .....</b>	<b>51</b>

Figure 1-1. HP 9000 rp4410 and HP 9000 rp4440 Server . . . . .	11
Figure 1-2. Airflow Through HP 9000 rp4410 and HP 9000 rp4440 Server. . . . .	20
Figure 2-1. Raised Floor Metal Strip Ground System . . . . .	28
Figure 2-2. Delivery Survey (Part 1) . . . . .	46
Figure 2-3. Delivery Survey (Part 2) . . . . .	47



---

# Preface

This preface contains the following sections:

- Intended Audience
- What's New?
- Notational Conventions
- Reader Comments and Feedback
- Related Information
- Printing History

## Intended Audience

This document is intended to provide technical product and support information for authorized service providers, customer system administrators, and HP support personnel.

## What's New?

- The layout of this document was changed to improve usability.

## Notational Conventions

The following notational conventions are used in this publication.

---

**WARNING** A warning lists requirements that you must meet to avoid personal injury.

---

---

**CAUTION** A caution provides information required to avoid losing data or avoid losing system functionality.

---

---

**NOTE** A note highlights useful information such as restrictions, recommendations, or important details about HP product features.

---

- Commands and options are represented using this font.
- **Text that you type exactly as shown** is represented using **this font**.
- *Text to be replaced with text that you supply* is represented using *this font*.

Example:

“Enter the `ls -l filename` command” means you must replace *filename* with your own text.

- **Keyboard keys and graphical interface items (such as buttons, tabs, and menu items)** are represented using **this font**.

Examples:

The **Control** key, the **OK** button, the **General** tab, the **Options** menu.

- **Menu** → **Submenu** represents a menu selection you can perform.

Example:

“Select the **Partition** → **Create Partition** action” means you must select the **Create Partition** menu item from the **Partition** menu.

- Example screen output is represented using this font.

## Reader Comments and Feedback

HP welcomes your feedback on this publication. Please address your comments to [edit@presskit.rsn.hp.com](mailto:edit@presskit.rsn.hp.com) and note that you will not receive an immediate reply. All comments are appreciated.

## Related Information

You can find other information on HP server hardware management, Microsoft® Windows®, and diagnostic support tools in the following publications.

### Web Site for HP Technical Documentation:

<http://docs.hp.com>

The main Web site for HP technical documentation is <http://docs.hp.com>, which has complete information available for free.

### Server Hardware Information:

<http://docs.hp.com/hpux/hw/>

The <http://docs.hp.com/hpux/hw/> Web site is the systems hardware portion of the docs.hp.com and provides HP nPartition server hardware management details, including site preparation, installation, and more.

### Windows Operating System Information

You can find information about administration of the Microsoft® Windows® operating system at the following Web sites, among others:

- [http://docs.hp.com/windows\\_nt/](http://docs.hp.com/windows_nt/)
- <http://www.microsoft.com/technet/>

### Diagnostics and Event Monitoring: Hardware Support Tools

Complete information about HP's hardware support tools, including online and offline diagnostics and event monitoring tools, is at the <http://docs.hp.com/hpux/diag/> Web site. This site has manuals, tutorials, FAQs, and other reference material.

### Web Site for HP Technical Support:

<http://us-support2.external.hp.com>

HP's IT resource center Web site at <http://us-support2.external.hp.com/> provides comprehensive support information for IT professionals on a wide variety of topics, including software, hardware, and networking.

### Books about HP-UX Published by Prentice Hall

The <http://www.hp.com/hpbooks/> Web site lists the HP books that Prentice Hall currently publishes, such as HP-UX books including:



- *HP-UX 11i System Administration Handbook*  
[http://www.hp.com/hpbooks/prentice/ptr\\_0130600814.html](http://www.hp.com/hpbooks/prentice/ptr_0130600814.html)
- *HP-UX Virtual Partitions*  
[http://www.hp.com/hpbooks/prentice/ptr\\_0130352128.html](http://www.hp.com/hpbooks/prentice/ptr_0130352128.html)

HP Books are available worldwide through bookstores, online booksellers, and office and computer stores.

## Printing History

The Printing History below identifies the edition dates of this manual. Updates are made to this publication on an unscheduled, *as needed*, basis. The updates will consist of a complete replacement manual and pertinent on-line or CD-ROM documentation.

Second Edition	.....	July 2004
Third Edition	.....	April 2005



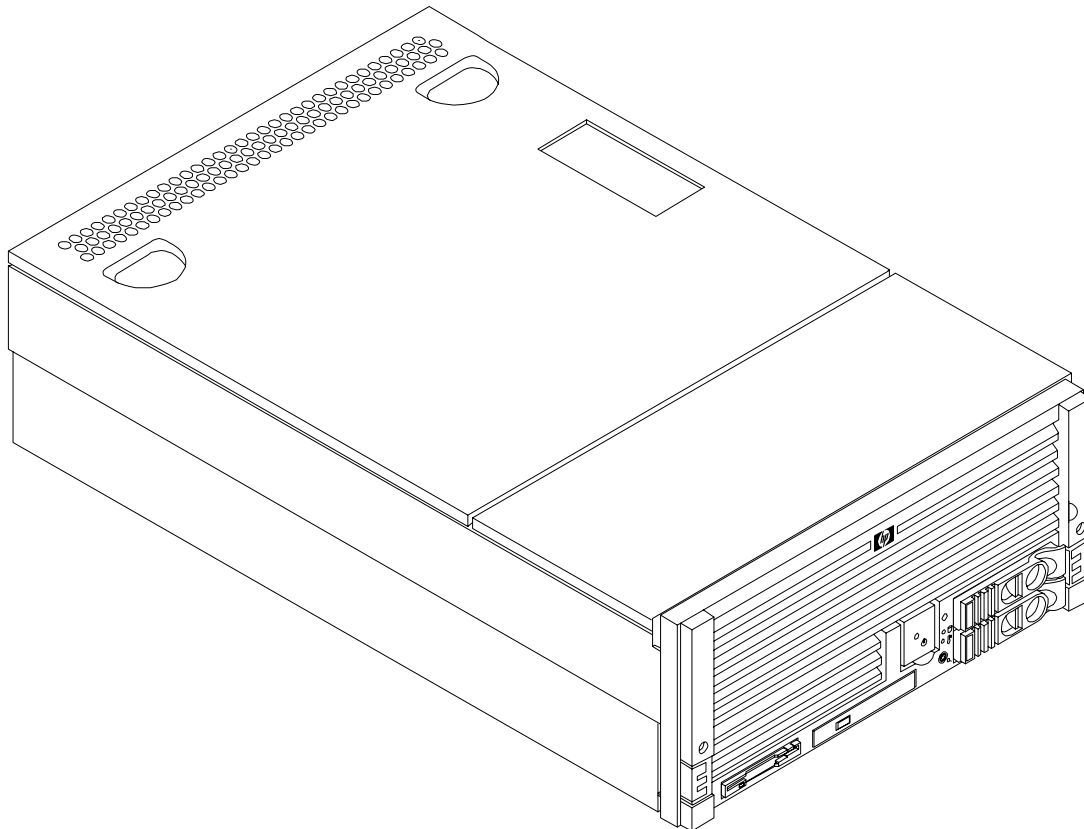
---

# 1 System Specifications

---

## System Configuration

**Figure 1-1** HP 9000 rp4410 and HP 9000 rp4440 Server



The following table describes the component options for the HP 9000 rp4410 and HP 9000 rp4440 servers.

**Table 1-1** Minimum/Maximum Configuration

Component	rp4410	rp4440
Microprocessors	One or two dual processor modules, each containing two PA RISC 800 MHz/1.5 MB cache or 1 GHz/1.5 MB cache. The CPUs are available with 32 MB or 64 MB L2 cache. A single CPU or all installed CPUs are activated	Up to four dual processor modules, each containing two PA RISC 800 MHz/1.5 MB cache or 1 GHz/1.5 MB cache. The CPUs are available with 32 MB or 64 MB L2 cache. All installed CPUs (2, 4, 6, or 8) are activated

**Table 1-1 Minimum/Maximum Configuration (Continued)**

Component	rp4410	rp4440
Memory	Supports up to 16 double data rate (DDR) registered ECC memory, in PC2100 DIMMs. An option is available that allows use of up to 32 DDR DIMMs. Maximum memory is 128 GB. Supported DDR DIMM sizes: 256 MB and 512 MB, 1 GB, 2 GB, and 4 GB	Supports up to 16 double data rate (DDR) registered ECC memory, in PC2100 DIMMs. An option is available that allows use of up to 32 DDR DIMMs. Maximum memory is 128 GB. Supported DDR DIMM sizes: 256 MB, 512 MB, 1 GB, 2 GB, and 4 GB
HDDs	2-36 GB, 15K RPM Ultra320 SCSI hot-plug disks or 2-73 GB, 15K RPM Ultra320 SCSI hot-plug disks or 2-146 GB, 10K RPM Ultra320 SCSI hot-plug disks	2-36 GB, 15K RPM Ultra320 SCSI hot-plug disks or 2-73 GB, 15K RPM Ultra320 SCSI hot-plug disks or 2-146 GB, 10K RPM Ultra320 SCSI hot-plug disks
SCSI	Integrated Ultra-3 SCSI dual channel controller; 80 Mb/s transfer rate with two external 68-pin connectors	Integrated Ultra-3 SCSI dual channel controller; 80 Mb/s transfer rate with two external 68-pin connectors
LAN	PCI GB, fast ethernet controller	PCI GB, fast ethernet controller
PCI Slots	Four 64-bit PCI-X slots, 66 MHz, 3.3V slots and two 64-bit PCI-X slots, 133 MHz, 3.3V slots	Four 64-bit PCI-X slots, 66 MHz, 3.3V slots and two 64-bit PCI-X slots, 133 MHz, 3.3V slots
Core I/O	Three serial ports, two USB ports, integrated RJ-45 LAN	Three serial ports, two USB ports, integrated RJ-45 LAN
DVD-ROM	DVD-R/CD-ROM drive; IDE interface; 48x speed	DVD-R/CD-ROM drive; IDE interface; 48x speed
External storage	2 external SCSI ports	2 external SCSI ports
Power supply	1 power supply is standard. You can install a second power supply (optional) in a 1+1 configuration	1 power supply is standard. You can install a second power supply (optional) in a 1+1 configuration

## Dimensions and Weights

This section provides dimensions and weights of HP 9000 rp4410 and HP 9000 rp4440 servers.

### Component Dimensions

**Table 1-2 Server Component Dimensions**

Dimension	Value
Height-inches (centimeters) Rack configuration Stand-mounted	6.87 (17.46) _____
Width-inches (centimeters) Rack configuration Stand-mounted	17.32 (44) _____
Depth-inches (centimeters) Rack configuration Stand-mounted	25.13 (63.85) _____
Weight-pounds (kilograms) Rack configuration rp4410 minimum configuration rp4410 maximum configuration Stand-mounted rp4410 minimum configuration rp4410 maximum configuration Rack configuration rp4440 minimum configuration rp4440 maximum configuration Stand-mounted rp4440 minimum configuration rp4440 maximum configuration	 _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ 100 lbs (45 kg)
Rack units	4U

---

## Grounding

The site building shall provide a safety ground or protective earth for each AC service entrance to all cabinets.

Install a PE (protective earthing) conductor that is identical in size, insulation material, and thickness to the branch-circuit supply conductors. The PE conductor must be green with yellow stripes. The earthing conductor is to be connected from the unit to the building installation earth or, if supplied by a separately derived system, at the supply transformer or motor-generator set grounding point.

## Electrical Specifications

This section provides electrical specifications for your system.

### AC Power Cords

Table 1-3 lists the various power cables available for use with the HP 9000 rp4410 and HP 9000 rp4440 servers.

**Table 1-3 Power Cords**

Part Number	Description	Country
8120-5341	Pwr Crd C15/S Africa 2.5m BLACK CA ASSY 917	S. Africa
8120-1351	Pwr Crd C13/BS-1363 2.3m BLACK CA ASSY 900	UK & HK & Singapore
8120-1369	Pwr Crd C13/AS-3112 2.0m GRAY CA ASSY 901	Australia
8120-1689	Pwr Crd C13/CEE 7 2.0m BLACK CA ASSY 902	Europe
8120-2104	Pwr Crd C13/SEV 12 2.0m BLACK CA ASSY 906	Swiss
8120-6814	Pwr-Crd OPT-912 3-COND 2.25-M-LG 912	Denmark
8120-0698	Pwr Crd C13/6-15P 0.0m BLACK CA ASSY 904 / 918	N. Amer 250V / Japan
8120-6800	Pwr-Crd OPT-919 3-COND 2.3-M-LG 919	Israel
8120-8390	Pwr Crd C15/CEI 23-16 2.5m BLACK CA ASSY 920	Argentina
8120-8389	Pwr Crd C15/CEI 23-16 2.5m BLACK CA ASSY 921	Chile
8120-8376	Pwr Crd C13/GB-1002 2.236m GRAY CA ASSY 922	China
8121-0668	Pwr-Crd OPT-927 3-COND 2.3-M-LG FLNT 927	S. America
8120-6514	C13/C14 Jumper cord	

### Circuit Breaker

The marked electrical for the HP server is eight amps. The recommended circuit breaker size is 12 amps per line cord (2 maximum) for North America. For countries outside North America, consult the local electrical authority that has jurisdiction for the recommended circuit breaker size.

## System Power Specifications

Table 1-4 lists the AC power requirements for the server. The following tables provide information to help determine the amount of AC power needed for your computer room.

**Table 1-4 System Power Specifications**

Specification	Value
Nominal input voltage	200 – 240 VAC
Minimum operating voltage	180 VAC
Maximum operating voltage	264 VAC
Frequency range (minimum – maximum)	50 – 60 Hz
Number of phases	1
Maximum input current	8 A RMS
Maximum inrush current (maximum configuration)	rp4410: 100A (peak), 55A (average) 0 msec – 1 msec 55A (peak), 33A (average) 1 msec – 2 msec 5A (peak), 22A (average) 2 msec – 10 sec 25A (peak), 15A (average) 10 msec – 150 msec rp4440: 100A (peak), 55A (average) 0 msec – 1 msec 55A (peak), 33A (average) 1 msec – 2 msec 5A (peak), 22A (average) 2 msec – 10 sec 25A (peak), 15A (average) 10 msec – 150 msec
Dropout carry through time at minimum line voltage	20 ms
Power factor correction	>0.95 at all loads of 90% – 100% of supply rating >0.75 at all loads of 50% – 90% of supply rating
Ground leakage current	<1.1 mA per line cord



Table 1-5 list maximum and typical power requirements for the HP 9000 rp4410 and HP 9000 rp4440 servers. These tables provide information to help determine the amount of AC power needed for your computer room.

**Table 1-5 System Power Requirements**

Power Required (50-60 Hz)	Watts	VA	Comments
Maximum configuration <sup>a</sup>	1368	1440	Maximum theoretical
Typical configuration <sup>b</sup>	1065	1125	Typical

- a. Maximum power is the sum of the worst case power consumption values of every subsystem in your HP 9000 rp4410 or HP 9000 rp4440 server. These worst case values should be used to calculate the worst case power consumption for your facility installation.
- b. Typical power consumption values were measured while running power intensive applications. These values are generally lower than maximum power numbers because all the subsystems in your HP server rarely draw maximum power simultaneously and for long durations.

## Power and Cooling

Typical power consumption and cooling values for HP 9000 rp4410 and HP 9000 rp4440 servers are listed in Table 1-6. The table lists power and cooling values associated with servers which contain the listed components. These power and cooling values are considered typical and not maximum for the configurations shown.

**Table 1-6 Typical Configuration Power Values**

CPU Qty	Memory Gigabytes	PCI Cards (assuming 10W each)	DVDs	Hard Disk Drives	Core I/O	Bulk Power Supplies	Typical Power-Watts	Typical Cooling-BTU/Hr
1	1 GB (4 DIMMs @ 256 MB ea.)	0	0	1	2	2	410	1399.74
2	32 GB <sup>a</sup> (32 DIMMs @ 1 GB ea.) <sup>b</sup>	0	0	1	1	1	540	1843.56
2	32 GB <sup>a</sup> (32 DIMMs @ 1 GB ea.) <sup>b</sup>	6	1	2	2	2	700	2389.80
4	32 GB <sup>a</sup> (32 DIMMs @ 1 GB ea.) <sup>b</sup>	0	1	2	2	2	895	3055.53

**Table 1-6 Typical Configuration Power Values (Continued)**

<b>CPU Qty</b>	<b>Memory Gigabytes</b>	<b>PCI Cards (assuming 10W each)</b>	<b>DVDs</b>	<b>Hard Disk Drives</b>	<b>Core I/O</b>	<b>Bulk Power Supplies</b>	<b>Typical Power-Watts</b>	<b>Typical Cooling-BTU/Hr</b>
4	32 GB <sup>a</sup>  (32 DIMMs @ 1 GB ea.) <sup>b</sup>	6	1	2	2	2	975	3328.65
4	32 GB <sup>a</sup>  (8 DIMMs @ 4 GB ea.)	0	1	2	2	2	915	3121.98
4	128 GB <sup>a</sup>  (32 DIMMs @ 4 GB ea.) <sup>b</sup>	6	1	2	2	2	3600	12283.2

- a. The maximum memory capacity is 128 GB.
- b. These memory configurations require the optional 32 DIMM slot memory extender board. The standard memory extender board has 16 DIMM slots.

## Environmental Specifications

This section provides the temperature and humidity requirements, noise emission, and air flow specifications for the HP server.

### Temperature and Humidity

The recommended operating range is 20°C to 25°C and 40% – 55% relative humidity. Ambient intake air temperature is often different from ambient room temperature; you should measure the operating temperature and humidity directly in front of the cabinet cooling air intakes rather than just checking ambient room conditions.

### Operating Environment

The system is designed to run continuously and meet reliability goals in an ambient temperature of 5°C to 35°C (+40°F to +95°F) at sea level. The maximum allowable temperature is de-rated 1°C per 1,000 feet of elevation above 5,000 feet above sea level up to 30°C at 10,000 feet. For optimum reliability and performance, the recommended operating range is 20°C to 25°C and 40% – 55% relative humidity.

### Environmental Temperature Sensor

The server includes internal sensors that monitor input air temperature and server operating temperatures. The ambient air temperature is measured using a sensor placed on the system I/O board. Data from the sensor is used to control the fan speed and also to initiate system overtemp shutdown.

### Nonoperating Environment

The system is designed to withstand ambient temperatures between –40°C to 70°C under non-operating conditions.

## Cooling

### CPU/Memory Cooling

The server incorporates front to back airflow across the processor and memory extender boards and through the HDD backplane. Two 127 mm dual fan assemblies, mounted vertically in the center of the chassis, pull air through the processor and memory section, and push air through the PCI section.

Each processor/memory dedicated dual fan assembly is controlled by smart fan control circuits that are embedded in the system I/O board. The smart fan control circuit receives fan control input from the system fan controller in the I/O board, and returns fan status information to the system fan controller. The smart fan circuit controls the power and the pulse-width-modulated control signal to the fan and monitors the speed indicator back from each of the fans. The fan status LED is driven by the smart fan circuit. The location of the fan status LED is on the diagnostic board inside the system.

### Bulk Power Supply Cooling

Cooling for the bulk power supplies is provided by the one 120 mm dual fan assembly and one externally mounted 60 mm power supply fan. Air is pushed into both power supply bays by the 120 mm fan assembly and exhausted out the rear by a 60 mm fan (one fan per PSU).

Air flows out of the rear of the chassis with minimal leakage into the cell airflow plenum.

---

**NOTE** A power supply filler is required in the unused power supply slot to maintain proper airflow throughout the system.

---

### PCI/Mass Storage Section Cooling

Two dual fan assemblies located at the center of the chassis provide airflow for all of the PCI slots. Airflow is over the processor and memory extender boards and into the PCI section. The fans are controlled by the system temperature and run at the speed necessary to maintain proper internal temperature throughout the chassis.

The air is pulled through openings in the front cover and the mass storage devices, and pushed through the PCI card cage.

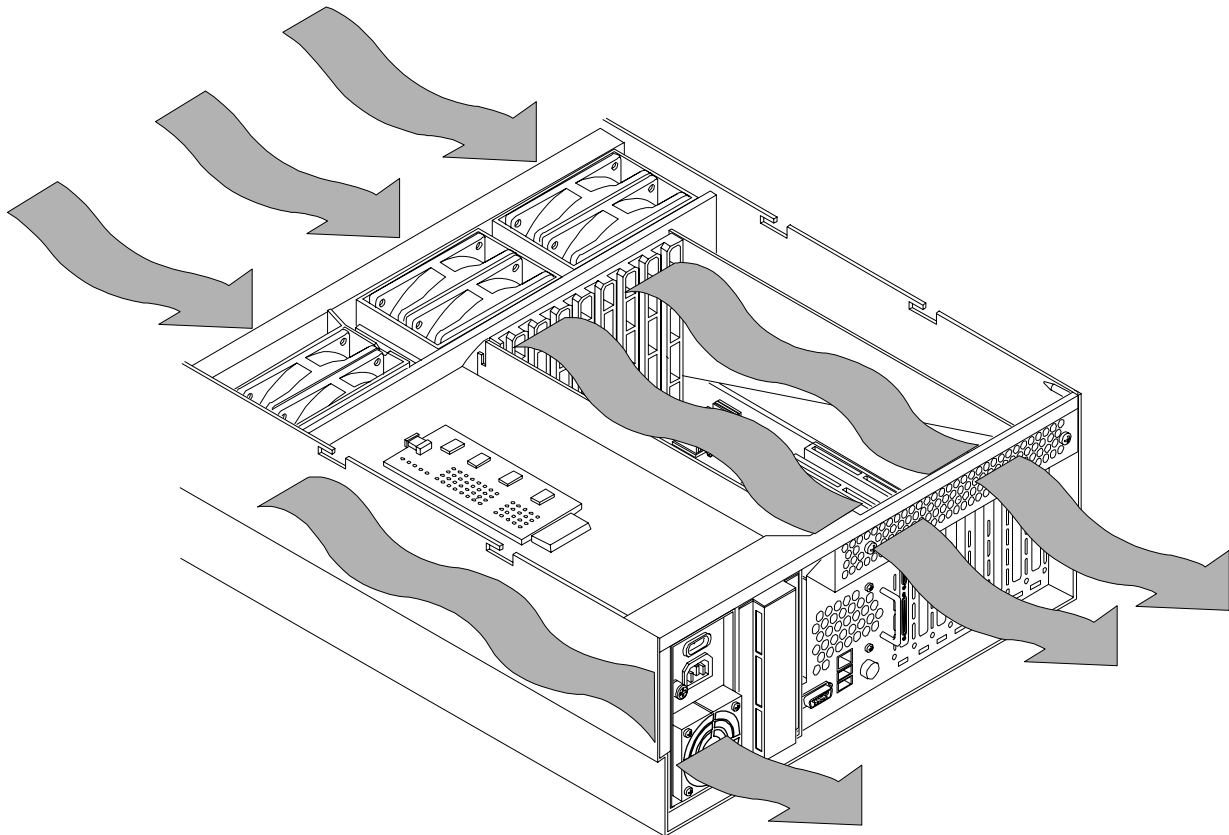
Perforation is provided between and above the PCI card cage to allow proper exhaust ventilation to maintain the required temperature rating of the PCI cards.

---

**CAUTION** For maximum cooling effects, ensure that the chassis ventilation holes are not blocked or covered after installation.

---

**Figure 1-2 Airflow Through HP 9000 rp4410 and HP 9000 rp4440 Server**



## Acoustic Noise Specification

The acoustic noise specification for the HP 9000 rp4410 or HP 9000 rp4440 servers is as follows:

- 53 db LpA (sound pressure level at bystander position in a dedicated computer room environment temperature of <25°C)



---

## 2 General Site Preparation Guidelines

The following information provides general principles and practices to consider before the installation or operation of an HP 9000 rp4410 or HP 9000 rp4440 server.

---

### Electrical Factors

**NOTE** Electrical practices and suggestions in this guide are based on North American practices. For regions and areas outside North America, local electrical codes will take precedence over North American electrical codes.

An example would be the recommendation that the PE (Protective Earthing) conductor be green with yellow stripes. This requirement is a North American directive and does not override the local code requirements for a region or area outside North America.

Local authority has jurisdiction (LAHJ) and should make the final decision regarding adherence to region-specific or area-specific electrical codes and guidelines.

---

Proper design and installation of a power distribution system for an HP 9000 rp4410 or HP 9000 rp4440 server requires specialized skills. Those responsible for this task must have a thorough knowledge and understanding of appropriate electrical codes and the limitations of the power systems for computer and data processing equipment.

In general, a well-designed power distribution system exceeds the requirements of most electrical codes. A good design, when coupled with proper installation practices, produces the most trouble-free operation.

A detailed discussion of power distribution system design and installation is beyond the scope of this document. However, electrical factors relating to power distribution system design and installation must be considered during the site preparation process.

The electrical factors discussed in this section are:

- Computer room safety
- Power consumption
- Electrical load requirements (circuit breaker sizing)
- Power quality
- Distribution hardware
- System installation guidelines

### Computer Room Safety

Inside the computer room, fire protection and adequate lighting (for equipment servicing) are important safety considerations. Federal and local safety codes govern computer installations.

#### Fire Protection

The National Fire Protection Association's Standard for the Protection of Electronic Computer Data Processing Equipment, NFPA 75, contains information on safety monitoring equipment for computer rooms.

## Electrical Factors

Most computer room installations are equipped with the following fire protection devices:

- Smoke detectors
- Fire and temperature alarms
- Fire extinguishing system

Additional safety devices are:

- Circuit breakers
- An emergency power cutoff switch
- Devices specific to the geographic location, such as, earthquake protection

### Lighting Requirements for Equipment Servicing

Adequate lighting and utility outlets in a computer room reduce the possibility of accidents during equipment servicing. Safer servicing is also more efficient and, therefore, less costly.

For example, adequate lighting reduces the chances of connector damage when cables are installed or removed.

The minimum recommended illumination level is 70 foot-candles (756 lumens per square meter) when the light level is measured at 30 inches (76.2 cm) above the floor.

### Working Space for Server Access

The recommended working space for performing maintenance on the server is three feet (91.4cm). The work space shall permit at least a 90° opening of equipment doors or hinged panels. When planning for the working space area, consider whether access to the server will be at the front, side, or rear of the server.

### Power Consumption

When determining power requirements, you must consider any peripheral equipment that will be installed during initial installation or as a later update. Refer to the applicable documentation for such devices to determine the power required to support these devices.

### Electrical Load Requirements (Circuit Breaker Sizing)

---

**NOTE** Local authority has jurisdiction (LAHJ) and should make the final decision regarding adherence to country-specific electrical codes and guidelines.

---

It is good practice to derate power distribution systems for one or more of the following reasons:

- To avoid nuisance tripping from load shifts or power transients, circuit protection devices should never be run above 80% of their root-mean-square (RMS) current ratings
- Safety agencies derate most power connectors to 80% of their RMS current ratings

### Power Quality

The HP 9000 rp4410 and HP 9000 rp4440 servers are designed to operate over a wide range of voltages and frequencies. The server is tested and shown to comply with EMC Specification EN50082. However, damage can occur if these ranges are exceeded. Severe electrical disturbances can exceed the design specifications of the equipment.



## Sources of Voltage Fluctuations

Voltage fluctuations, sometimes called glitches, affect the quality of electrical power. Common sources of these disturbances are:

- Fluctuations occurring within the facility's distribution system
- Utility service low-voltage conditions (such as sags or brownouts)
- Wide and rapid variations in input voltage levels
- Wide and rapid variations in input power frequency
- Electrical storms
- Large inductive sources (such as motors and welders)
- Faults in the distribution system wiring (such as loose connections)
- Microwave, radar, radio, or cell phone transmissions

## Power System Protection

You can protect the HP 9000 rp4410 and HP 9000 rp4440 servers from the sources of many of these electrical disturbances by using:

- A dedicated power distribution system
- Power conditioning equipment
- Over- and under-voltage detection and protection circuits
- Screening to cancel out the effects of undesirable transmissions
- Lightning arresters on power cables to protect equipment against electrical storms

Precautions have been taken during power distribution system design to provide immunity to power outages of less than one cycle. However, testing cannot conclusively rule out loss of service. Therefore, adherence to the following guidelines provides the best possible performance of power distribution systems for HP computer equipment:

- Dedicated power source—Isolates the server power distribution system from other circuits in the facility
- Missing-phase and low-voltage detectors—Shuts equipment down automatically when a severe power disruption occurs. For peripheral equipment, these devices are recommended but optional
- Online uninterruptible power supply (UPS)—Keeps input voltage to devices constant and should be considered if outages of one-half cycle or more are common. Refer to qualified contractors or consultants for each situation

## Distribution Hardware

This section describes wire selection and the types of raceways (electrical conduits) used in the distribution system.

### Wire Selection

Use copper conductors instead of aluminum; because aluminum's coefficient of expansion differs significantly from that of other metals used in power hardware. Because of this difference, aluminum conductors can cause connector hardware to work loose, overheat, and fail.

## Electrical Factors

### Raceway Systems (Electrical Conduits) (LAHJ)

Raceways (electrical conduits) form part of the protective ground path for personnel and equipment. Raceways protect the wiring from accidental damage and also provide a heatsink for the wires.

Any of the following types may be used:

- Electrical metallic tubing (EMT) thin-wall tubing
- Rigid (metal) conduit
- Liquidtight with RFI shield grounded (most commonly used under raised floors)
- Armored cable

### Building Distribution

All building feeders and branch circuitry should be in rigid metallic conduit with proper connectors (to provide ground continuity). Conduit that is exposed and subject to damage should be constructed of rigid galvanized steel.

## Grounding Systems

### IT Power System

This product has not been evaluated for connection to an IT power system (an AC distribution system having no direct connection to earth according to IEC 60950).

The HP 9000 rp4410 and HP 9000 rp4440 servers require two methods of grounding:

- Power distribution safety grounding
- High frequency intercabinet grounding

### Power Distribution Safety Grounding (LAHJ)

The power distribution safety grounding system consists of connecting various points in the power distribution system to earth ground using green (green and yellow) wire ground conductors. Having these ground connections tied to metal chassis parts that may be touched by computer room personnel protects them against shock hazard from current leakage and fault conditions.

Power distribution systems consist of several parts. HP recommends that these parts be solidly interconnected to provide an equipotential ground to all points.

### Main Building Electrical Ground

The main electrical service entrance equipment should have an earth ground connection, as required by applicable codes. Connections such as a grounding rod, building steel, or a conductive type cold water service pipe provide an earth ground.

### Electrical Conduit Ground

All electrical conduits should be made of rigid metallic conduit that is securely connected together or bonded to panels and electrical boxes, so as to provide a continuous grounding system.

### Power Panel Ground

Each power panel should be grounded to the electrical service entrance with green (green and yellow) wire ground conductors. The green (green and yellow) wire ground conductors should be sized per applicable codes (based on circuit over current device ratings).

---

**NOTE** The green wire ground conductor mentioned above may be a black wire marked with green tape (LAHJ).

---

### Computer Safety Ground

Ground all computer equipment with the green (green and yellow) wire included in the branch circuitry. The green (green and yellow) wire ground conductors should be connected to the appropriate power panel and should be sized per applicable codes (based on circuit over current device ratings).

### Dual Power Source Grounding

When dual power sources are utilized, strong consideration should be given to measure voltage potentials. The use of dual power might create an electrical potential that can be harmful to personnel and might cause performance issues for the equipment.

Dual power sources might originate from two different transformers or two different UPS devices. Voltage potentials from ground pin to ground pin of these sources should be measured and verified to be at or near 0.0 volts. Voltage levels that deviate or are measured above 3.0 volts should be further investigated. Increased voltages might be hazardous to personnel, and should be further investigated.

### Cabinet Performance Grounding (High Frequency Ground)

Signal interconnects between system cabinets require high frequency ground return paths. Connect all cabinets to site ground.

---

**NOTE** In some cases power distribution system green (green and yellow) wire ground conductors are too long and inductive to provide adequate high frequency ground return paths. Therefore, a ground strap (customer-supplied) should be used for connecting the system cabinet to the site grounding grid (customer-supplied). When connecting this ground, ensure that the raised floor is properly grounded for high frequency.

---

Power panels located in close proximity to the computer equipment should also be connected to the site grounding grid. Methods of providing a sufficiently high frequency ground grid are described in the next sections.

### Raised Floor “High Frequency Noise” Grounding

If a raised floor system is used, install a complete signal grounding grid for maintaining equal potential over a broad band of frequencies. The grounding grid should be connected to the equipment cabinet and electrical service entrance ground at multiple connection points using a minimum #6 AWG (16 mm<sup>2</sup>) wire ground conductor. The following figure illustrates a metallic strip grounding system.

---

**NOTE** Regardless of the grounding connection method used, the raised floor should be grounded as an absolute safety minimum.

---

HP recommends the following approaches:

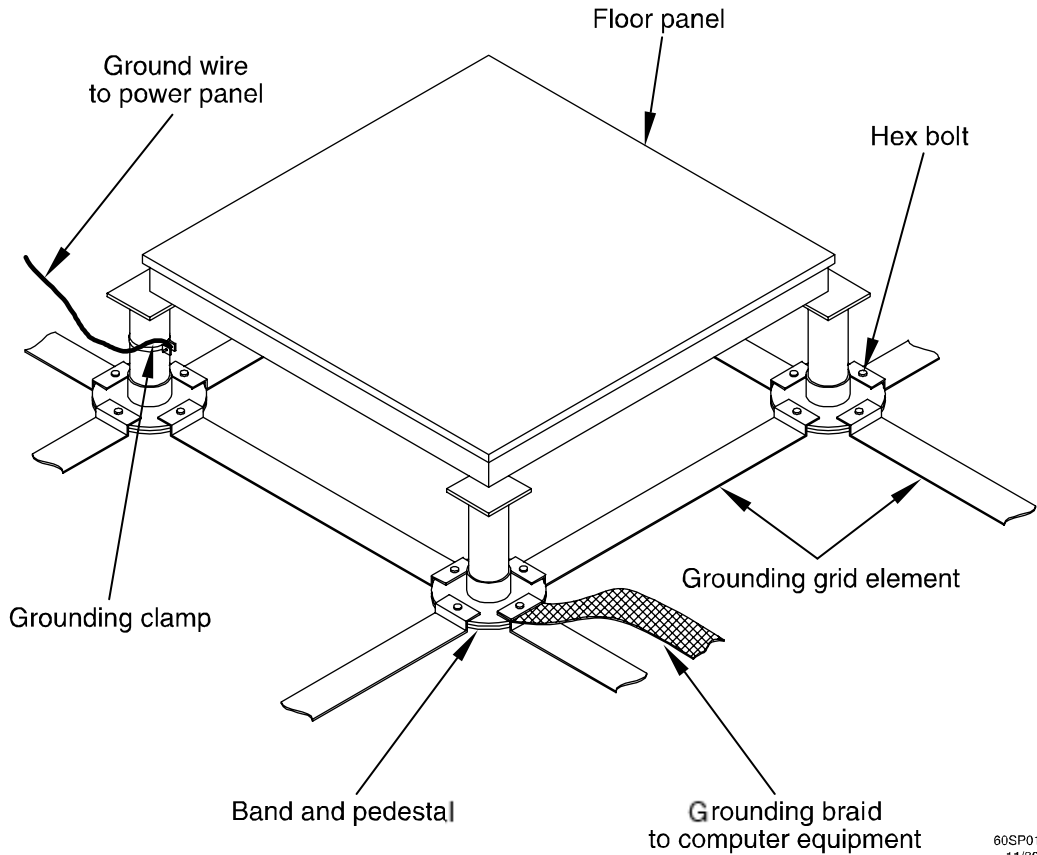
- Excellent—Add a grounding grid to the subfloor. The grounding grid should be made of copper strips mounted to the subfloor. The strips should be 0.032 in. (0.08 cm) thick and a minimum of 3.0 in. (8.0 cm) wide

Connect each pedestal to four strips using 1/4 in. (6.0 mm) bolts tightened to the manufacturer’s torque recommendation

Electrical Factors

- Better— A grounded #6 AWG minimum copper wire grid mechanically clamped to floor pedestals and properly bonded to the building or site ground
- Good—Use the raised floor structure as a ground grid. In this case, the floor must be designed as a ground grid with bolted down stringers and corrosion resistant plating (to provide low resistance and attachment points for connection to service entrance ground and HP computer equipment). The use of conductive floor tiles with this style of grid further enhances ground performance. The structure needs to be mechanically bonded to a known good ground point

**Figure 2-1**      **Raised Floor Metal Strip Ground System**



## Equipment Grounding Implementation Details

Connect all HP equipment cabinets to the site ground grid as follows:

- Step 1.** Attach one end of each ground strap to the applicable cabinet ground lug.
- Step 2.** Attach the other end to the nearest pedestal base (raised floor) or cable trough ground point (nonraised floor).
- Step 3.** Check that the braid contact on each end of the ground strap consists of a terminal and connection hardware (a 1/4-in. [6.0-mm] bolt, nuts, and washers).
- Step 4.** Check that the braid contact connection points are free of paint or other insulating material and treated with a contact enhancement compound (similar to Burndy Penetrox).

## System Installation Guidelines

This section contains information about installation practices. Some common pitfalls are highlighted. Both power cable and data communications cable installations are discussed.

---

**NOTE** In domestic installations, the proper receptacles should be installed prior to the arrival of HP equipment. Refer to the appropriate installation guide for installation procedures.

---

### Wiring Connections

Expansion and contraction rates vary among different metals. Therefore, the integrity of an electrical connection depends on the restraining force applied. Connections that are too tight compress or deform the hardware and cause it to weaken. This usually leads to high impedance, preventing circuit breakers from tripping when needed, or can contribute to a buildup of high frequency noise.

---

**CAUTION** Connections that are too loose or too tight can have a high impedance that causes serious problems, such as erratic equipment operation. A high impedance connection overheats and sometimes causes fire or high temperatures that can destroy hard-to-replace components such as distribution panels or system bus bars.

---

Wiring connections must be properly torqued. Many equipment manufacturers specify the proper connection torque values for their hardware.

Ground connections must only be made on a conductive, nonpainted surface. When equipment vibration is present, lock washers must be used on all connections to prevent connection hardware from working loose.

### Data Communications Cables

Power transformers create high-energy fields in the form of electromagnetic interference (EMI). Heavy foot traffic can create electrostatic discharge (ESD) that can damage electronic components. Route data communications cables away from these areas. Use shielded data communications cables that meet approved industry standards to reduce the effects of external fields.

## Environmental Elements

The following environmental elements can affect an HP 9000 rp4410 or HP 9000 rp4440 server installation:

- Computer room preparation
- Cooling requirements
- Humidity level
- Air conditioning ducts
- Dust and pollution control
- Electrostatic discharge (ESD) prevention
- Acoustics (noise reduction)

## Computer Room Preparation

The following guidelines are recommended when preparing a computer room for installation of an HP 9000 rp4410 or HP 9000 rp4440 server:

- Locate the computer room away from the exterior walls of the building to avoid the heat gain from windows and exterior wall surfaces
- When exterior windows are unavoidable, use windows that are double- or triple-glazed and shaded to prevent direct sunlight from entering the computer room
- Maintain the computer room at a positive pressure relative to surrounding spaces
- Use a vapor barrier installed around the entire computer room envelope to restrain moisture migration
- Caulk and vapor seal all pipes and cables that penetrate the envelope
- Use at least a 12-inch raised floor system for minimum favorable room air distribution system (underfloor distribution)
- Ensure a minimum clearance of 12 inches between the top of the server cabinet and the ceiling to allow for return air flow and ensure that all ceiling tiles are in place
- Allow 18 inches (or local code minimum clearance) from the top of the server cabinet to the fire sprinkler heads

## Cooling Requirements

Air conditioning equipment requirements and recommendations are described in the following sections.

### Basic Air Conditioning Equipment Requirements

The cooling capacity of the installed air conditioning equipment for the computer room should be sufficient to offset the computer equipment dissipation loads, as well as any space envelope heat gain. This equipment should include:

- Air filtration
- Cooling or dehumidification
- Humidification

- Reheating
- Air distribution
- System controls adequate to maintain the computer room within specified operating ranges

Lighting and personnel must also be included. For example, a person dissipates about 450 BTUs per hour while performing a typical computer room task.

### **Air Conditioning System Guidelines**

The following guidelines are recommended when designing an air conditioning system and selecting the necessary equipment:

- The air conditioning system that serves the computer room should be capable of operating 24 hours a day, 365 days a year. It should also be independent of other systems in the building
- Consider the long-term value of server availability, redundant air conditioning equipment, or capacity
- The system should be capable of handling any future server installations, including added accessories and additional servers and peripheral equipment
- Air conditioning equipment air filters should have a minimum rating of 45% (based on ASHRAE Standard 52-76, Dust Spot Efficiency Test)
- Introduce only enough outside air into the system to meet building code requirements (for human occupancy) and to maintain a positive air pressure in the computer room

### **Air Conditioning System Types**

The following three air conditioning system types are listed in order of recommendation:

- Complete self-contained package unit(s) with remote condenser(s). These systems are available with up or down discharge and are usually located in the computer room
- Chilled water package unit with remote chilled water plant. These systems are available with up or down discharge and are usually located in the computer room
- Central station air handling units with remote refrigeration equipment. These systems are usually located outside the computer room

### **Basic Air Distribution Systems**

A basic air distribution system includes supply air and return air.

An air distribution system should be zoned to deliver an adequate amount of supply air to the cooling air intake vents of the server equipment cabinets. Supply air temperature should be maintained within the following parameters:

- Ceiling supply system—From 55°F (12.8°C) to 60°F (15.6°C)
- Floor supply system—At least 60°F (15.6°C)

If a ceiling plenum return air system or a ducted ceiling return air system is used, the return air grill(s) in the ceiling should be above the exhaust area or the exhaust row.

The following three types of air distribution system are listed in order of recommendation:

- Underfloor air distribution system—Downflow air conditioning equipment located on the raised floor of the computer room uses the cavity beneath the raised floor as a plenum for the supply air

Return air from an underfloor air distribution system can be ducted return air (DRA) above the ceiling

## Environmental Elements

Perforated floor panels (available from the raised floor manufacturer) should be located around the front of the system cabinets. Supply air emitted through the perforated floor panels is then available near the cooling air intake vents of the server cabinets

- Ceiling plenum air distribution system—Supply air is ducted into the ceiling plenum from upflow air conditioning equipment located in the computer room or from an air handling unit (remote)

The ceiling construction should resist air leakage. Place perforated ceiling panels (with down discharge air flow characteristics) around the front of the system cabinets. The supply air emitted downward from the perforated ceiling panels is then available near the cooling air intake vents of the server cabinets

Return air should be ducted back to the air conditioning equipment through the return air duct above the ceiling

- Above ceiling ducted air distribution system—Supply air is ducted into a ceiling diffuser system from upflow air conditioning equipment located in the computer room or from an air handling unit (remote)

Return air from an above ceiling ducted air distribution system may be ducted return air (DRA) above the ceiling, or ceiling plenum return air (CPRA)

Adjust the supply air diffuser system grilles to direct the cooling air downward around the front of the server cabinets. The supply air is then available near the cooling air intake vents of the HP 9000 rp4410 and HP 9000 rp4440 servers

### Air Conditioning System Installation

All air conditioning equipment, materials, and installation must comply with any applicable construction codes. Installation of the various components of the air conditioning system must also conform to the air conditioning equipment manufacturer's recommendations.

### Air Conditioning Ducts

Use separate computer room air conditioning duct work. If it is not separate from the rest of the building, it might be difficult to control cooling and air pressure levels. Duct work seals are important for maintaining a balanced air conditioning system and high static air pressure. Adequate cooling capacity means little if the direction and rate of air flow cannot be controlled because of poor duct sealing. Also, the ducts should not be exposed to warm air, or humidity levels may increase.

### Humidity Level (RH)

Maintain proper humidity levels at 40 to 55% RH. High humidity causes galvanic actions to occur between some dissimilar metals. This eventually causes a high resistance between connections, leading to equipment failures. High humidity can also have an adverse effect on some magnetic tapes and paper media.

---

**CAUTION** Low humidity contributes to undesirably high levels of electrostatic charges. This increases the electrostatic discharge (ESD) voltage potential. ESD can cause component damage during servicing operations. Paper feed problems on high-speed printers are usually encountered in low-humidity environments.

---

Low humidity levels are often the result of the facility heating system and occur during the cold season. Most heating systems cause air to have a low humidity level, unless the system has a built-in humidifier.

### Dust and Pollution Control

Computer equipment can be adversely affected by dust and microscopic particles in the site environment.



Specifically, disk drives, tape drives, and some other mechanical devices can have bearing failures resulting from airborne abrasive particles. Dust may also blanket electronic components like printed circuit boards, causing premature failure due to excess heat and humidity build up on the boards. Other failures to power supplies and other electronic components can be caused by metallically conductive particles, including zinc whiskers. These metallic particles are conductive and can short circuit electronic components. Use every effort to ensure that the environment is as dust- and particulate-free as possible. See the following heading titled **Metallic Particulate Contamination** for additional details.

Smaller particles can pass through some filters, and over a period of time, cause problems in mechanical parts. Small dust particles can be prevented from entering the computer room by maintaining the air conditioning system at a high static air pressure level.

Other sources of dust, metallic, conductive, abrasive, or microscopic particles can be present. Some sources of these particulates are:

- Subfloor shedding
- Raised floor shedding
- Ceiling tile shedding

These particulates are not always visible to the naked eye. A good check to determine their possible presence is to check the underside of the tiles. The tile should be shiny, galvanized, and free from rust.

The computer room should be kept clean. The following guidelines are recommended:

- Smoking—Establish a no-smoking policy. Cigarette smoke particles are eight times larger than the clearance between disk drive read/write heads and the disk surface
- Printer—Locate printers and paper products in a separate room to eliminate paper particulate problems
- Eating or drinking—Establish a no-eating or drinking policy. Spilled liquids can cause short circuits in equipment such as keyboards
- Tile floors—Use a dust-absorbent cloth mop rather than a dry mop to clean tile floors

Special precautions are necessary if the computer room is near a source of air pollution. Some air pollutants, especially hydrogen sulfide (H<sub>2</sub>S), are not only unpleasant but corrosive as well. Hydrogen sulfide damages wiring and delicate sound equipment. The use of activated charcoal filters reduces this form of air pollution.

## **Metallic Particulate Contamination**

Metallic particulates can be especially harmful around electronic equipment. This type of contamination may enter the data center environment from a variety of sources, including but not limited to raised floor tiles, worn air conditioning parts, heating ducts, rotor brushes in vacuum cleaners, or printer component wear. Because metallic particulates conduct electricity, they have an increased potential for creating short circuits in electronic equipment. This problem is exaggerated by the increasingly dense circuitry of electronic equipment.

Over time, very fine whiskers of pure metal can form on electroplated zinc, cadmium, or tin surfaces. If these whiskers are disturbed, they may break off and become airborne, possibly causing failures or operational interruptions. For over 50 years, the electronics industry has been aware of the relatively rare but possible threat posed by metallic particulate contamination. During recent years, a growing concern has developed in computer rooms where these conductive contaminants are formed on the bottom of some raised floor tiles.

Although this problem is relatively rare, it may be an issue within your computer room. Since metallic contamination can cause permanent or intermittent failures on your electronic equipment, HP strongly recommends that your site be evaluated for metallic particulate contamination before installation of electronic equipment.

## Electrostatic Discharge (ESD) Prevention

Static charges (voltage levels) occur when objects are separated or rubbed together. The voltage level of a static charge is determined by the following factors:

- Types of materials
- Relative humidity
- Rate of change or separation

**Table 2-1 Effect of Humidity on ESD Charge Levels**

Personnel Activity <sup>a</sup>	Humidity <sup>b</sup> and Charge Levels (voltages) <sup>c</sup>			
	26%	32%	40%	50%
Person walking across a linoleum floor	6,150V	5,750V	4,625V	3,700V
Person walking across a carpeted floor	18,450V	17,250V	13,875V	11,100V
Person getting up from a plastic chair	24,600V	23,000V	18,500V	14,800V

- a. Source: B.A. Unger, *Electrostatic Discharge Failures of Semiconductor Devices* (Bell Laboratories, 1981).
- b. For the same relative humidity level, a high rate of airflow produces higher static charges than a low airflow rate.
- c. Some data in this table has been extrapolated.

## Static Protection Measures

Follow these precautions to minimize possible ESD-induced failures in the computer room:

- Maintain recommended humidity level and airflow rates in the computer room
- Install conductive flooring (conductive adhesive must be used when laying tiles)
- Use conductive wax if waxed floors are necessary
- Ensure that all equipment and flooring are properly grounded and are at the same ground potential
- Use conductive tables and chairs
- Use a grounded wrist strap (or other grounding method) when handling circuit boards
- Store spare electronic modules in antistatic containers

## Acoustics

Computer equipment and air conditioning blowers cause computer rooms to be noisy. Ambient noise level in a computer room can be reduced as follows:

- Dropped ceiling—Cover with a commercial grade of fire-resistant, acoustic rated, fiberglass ceiling tile
- Sound deadening—Cover the walls with curtains or other sound deadening material
- Removable partitions—Use foam rubber models for most effectiveness

---

## Facility Characteristics

This section contains information about facility characteristics that must be considered for the installation or operation of an HP 9000 rp4410 or HP 9000 rp4440 server. Facility characteristics are:

- Floor loading
- Windows
- Altitude effects

### Floor Loading

The computer room floor must be able to support the total weight of the installed cabinets, servers, and associated equipment as they are moved into position.

Floor loading is usually not an issue in nonraised floor installations. The information presented in this section is directed toward raised floor installations.

---

**NOTE** An appropriate floor system consultant should verify any floor system under consideration for an HP 9000 rp4410 or HP 9000 rp4440 server installation.

---

### Raised Floor Loading

Raised floor loading is a function of the manufacturer's load specification and the positioning of the equipment relative to the raised floor grid. While HP cannot assume responsibility for determining the suitability of a particular raised floor system, it does provide information and illustrations for the customer or local agencies to determine installation requirements.

The following guidelines are recommended:

- Because many raised floor systems do not have grid stringers between floor stands, the lateral support for the floor stands depends on adjacent panels being in place. To avoid compromising this type of floor system while gaining under-floor access, remove only one floor panel at a time
- Larger floor grids (bigger panels) are generally rated for lighter loads

---

**CAUTION** Do not position or install any equipment cabinets on the raised floor system until you have carefully examined it to verify that it is adequate to support the appropriate installation.

---

**Floor Loading Terms**

The following table lists floor loading terms and definitions.

**Table 2-2 Floor Loading Term Definitions**

Term	Definition
Dead load	The weight of the raised panel floor system, including the understructure. Expressed in lb/ft <sup>2</sup> (kg/m <sup>2</sup> )
Live load	The load that the floor system can safely support. Expressed in lb/ft <sup>2</sup> (kg/m <sup>2</sup> )
Concentrated load	The load that a floor panel can support on a 1-in <sup>2</sup> (6.45-cm <sup>2</sup> ) area at the panel’s weakest point (typically the center of the panel), without the surface of the panel deflecting more than a predetermined amount
Ultimate load	The maximum load (per floor panel) that the floor system can support without failure. Failure expressed by floor panel(s) breaking or bending  Ultimate load is usually stated as load per floor panel
Rolling load	The load a floor panel can support (without failure) when a wheel of specified diameter and width is rolled across the panel
Average floor load	Computed by dividing total equipment weight by the area of its footprint. This value is expressed in lb/ft <sup>2</sup> (kg/m <sup>2</sup> )

**Average Floor Loading**

The average floor load value is not appropriate for addressing raised floor ratings at the floor grid spacing level. However, it is useful for determining floor loading at the building level, such as the area of solid floor or span of raised floor tiles covered by the server or cabinet footprint.

**Typical Raised Floor Site**

This section contains an example of a computer room raised floor system that is satisfactory for the installation of an HP 9000 rp4410 or HP 9000 rp4440 server.

Based on specific information provided by HP, Tate Access Floors has approved its Series 800 all-steel access floor with bolt-together stringers and 24 in. (61.0 cm) by 24 in. (61.0 cm) floor panels.

In the event that the flooring is being replaced or a new floor is being installed, Tate Access Floors recommends its Series 1250 all-steel access floor with bolt-together stringers and 24 in. (61.0 cm) by 24 in. (61.0 cm) floor panels be used to support the HP installation.

---

**NOTE** If the specific floor being evaluated or considered is other than a Tate Series 800 floor, the specific floor manufacturer must be contacted to evaluate the floor being used.

---

The following table lists specifications for the Tate Access Floors Series 800 raised floor system.

**Table 2-3 Typical Raised Floor Specifications**

Item <sup>a</sup>	Rating
Dead load	7 lb/ft <sup>2</sup> (34.2 kg/m <sup>2</sup> )
Live load	313 lb/ft <sup>2</sup> (1528.3 kg/m <sup>2</sup> )
Concentrated load <sup>b</sup>	1250 lb (567 kg)
Ultimate load	4,000 lb (1814 kg) per panel
Rolling load	400 lb (181 kg)
Average floor load	500 lb (227 kg)

a. From Table 2-2 on page 36

b. With 0.08 in (0.2 cm) of span maximum deflection

## Windows

Avoid housing computers in a room with windows. Sunlight entering a computer room may cause problems. Magnetic tape storage media is damaged if exposed to direct sunlight. Also, the heat generated by sunlight places an additional load on the cooling system.

## Space Requirements

This section contains information about space requirements for an HP 9000 rp4410 or HP 9000 rp4440 server installation. This data should be used as the basic guideline for space plan developments. Other factors, such as airflow, lighting, and equipment space requirements must also be considered.

### Delivery Space Requirements

There should be enough clearance to move equipment safely from the receiving area to the computer room. Permanent obstructions, such as pillars or narrow doorways, can cause equipment damage.

Delivery plans should include the possible removal of walls or doors.

### Operational Space Requirements

Other factors must be considered along with the basic equipment dimensions. Reduced airflow around equipment causes overheating, which can lead to equipment failure. Therefore, the location and orientation of air conditioning ducts, as well as airflow direction, are important. Obstructions to equipment intake or exhaust airflow must be eliminated.

The locations of lighting fixtures and utility outlets affect servicing operations. Plan equipment layout to take advantage of lighting and utility outlets. Do not forget to include clearance for opening and closing equipment doors.

Clearance around the cabinets must be provided for proper cooling airflow through the equipment.

If other equipment is located so that it exhausts heated air near the cooling air intakes of the server cabinets, larger space requirements are needed to keep ambient air intake to the server within the specified temperature and humidity ranges.

Space planning should also include the possible addition of equipment or other changes in space requirements. Equipment layout plans should also include provisions for the following:

- Channels or fixtures used for routing data cables and power cables
- Access to air conditioning ducts, filters, lighting, and electrical power hardware
- Power conditioning equipment
- Cabinets for cleaning materials
- Maintenance area and spare parts

### Floor Plan Grid

A floor plan grid is used to plan the location of equipment in the computer room. In addition to its use for planning, the floor plan grid should also be used when planning the locations of the following items:

- Air conditioning vents
- Lighting fixtures
- Utility outlets
- Doors
- Access areas for power wiring and air conditioning filters

- Equipment cable routing

## Conversion Factors and Formulas

The conversion factors provided here are intended to ease data calculation for systems that do not conform specifically to the configurations listed in this *Site Preparation Guide*. Listed below are the conversion factors used in this document, as well as additional conversion factors which may be helpful in determining those factors required for site planning.

### Conversion Factors

- Refrigeration
  - 1 watt = .86 kcal/h
  - 1 watt = 3.412 Btu/h
  - 1 watt =  $2.843 \times 10^{-4}$  tons
  - 1 ton = 200 Btu/min.
  - 1 ton = 12,000 Btu/h
  - 1 ton = 3,517.2W
- Metric Equivalents
  - 1 centimeter = 0.3937 in.
  - 1 meter = 3.28 ft.
  - 1 meter = 1.09 yds
  - 1 in. = 2.54 cm
  - 1 ft. = 0.305m
  - 1 CFM = 1.7 m<sup>3</sup>/h
- kVA Conversions
  - Three phase
  - $kVA = V \times A \times \sqrt{3} / 1000$
- Single phase
  - $kVA = V \times A / 1000$

### Formulas

- $kVA = \text{Voltage} \times \text{current (amps)}$
- $\text{Watts} = VA \times PF$
- $BTU = \text{Watts} \times 3.41$



## Sample of an Installation Schedule

The following schedule lists the sequence of events for a typical system installation:

- 60 days before installation
  - Floor plan design completed and mailed to HP (if required to be an HP task)
- 30 days before installation
  - Primary power and air conditioning installation completed
  - Telephone and data cables installed
  - Fire protection equipment installed
  - Major facility changes completed
  - Special delivery requirements defined
  - Site inspection survey completed
  - Delivery survey completed
  - A signed copy of the site inspection and delivery survey mailed to HP
  - Site inspection and predelivery coordination meeting arranged with a HP representative to review the inspection checklist and arrange an installation schedule
- 7 days before installation
  - Final check made with a HP site preparation specialist to resolve any last minute problems

---

<b>NOTE</b>	<p>Not all installations follow a schedule like the one noted above. Sometimes, a server is purchased through another vendor, which can preclude a rigid schedule. Other conditions could also prevent following this schedule. For those situations, consider a milestone schedule.</p> <ul style="list-style-type: none"><li>• Site Preparation—schedule with the customer as soon as possible after the order is placed</li><li>• Site Verification—schedule with the customer a minimum of one to two days before the HP server is scheduled to be installed</li></ul>
-------------	--

---

## Sample Site Inspection Checklist

The following table lists customer and HP information.

**Table 2-4 Customer and HP Information**

Customer Information	
Name:	Phone No:
Street Address:	City: or Town:
State or Province:	Country
Zip or postal code:	
Primary customer contact:	Phone No.:
Secondary customer contact:	Phone No.:
Traffic coordinator:	Phone No.:
HP information	
Sales representative:	Order No:
Representative making survey:	Date:
Scheduled delivery date:	

The following table is a site inspection checklist.

**Table 2-5 Site Inspection Checklist**

Please check either Yes or No. If No, include comment# or date				Comment or Date
Computer Room				
No.	Area or condition	Yes	No	
1.	Is there a completed floor plan?			
2.	Is there adequate space for maintenance needs? Front 36 in. (91.4 cm) minimum, rear 36 in. (91.4 cm) minimum are recommended clearances			
3.	Is access to the site or computer room restricted?			
4.	Is the computer room structurally complete? Expected date of completion?			
5.	Is a raised floor installed and in good condition?			
6.	Is the raised floor adequate for equipment loading?			

**Table 2-5 Site Inspection Checklist (Continued)**

Please check either Yes or No. If No, include comment# or date				Comment or Date
7.	Are there channels or cutouts for cable routing?			
8.	Is there a remote console telephone line available with an RJ11 jack?			
9.	Is a telephone line available?			
10.	Are customer supplied peripheral cables and LAN cables available and of the proper type?			
11.	Are floor tiles in good condition and properly braced?			
12.	Is floor tile underside shiny or painted? If painted, judge the need for particulate test			
<b>Power and Lighting</b>				
No.	Area or condition	Yes	No	
13.	Are lighting levels adequate for maintenance?			
14.	Are there AC outlets available for servicing needs? (such as, vacuuming)			
15.	Does the input voltage correspond to equipment specifications?			
15A	Is dual source power used? If so, identify type(s) and evaluate grounding.			
16.	Does the input frequency correspond to equipment specifications?			
17.	Are lightning arrestors installed inside the building?			
18.	Is power conditioning equipment installed?			
19.	Is there a dedicated branch circuit for equipment?			
20.	Is the dedicated branch circuit less than 250 feet (72.5 meters)?			
21.	Are the input circuit breakers adequate for equipment loads?			
<b>Safety</b>				
No.	Area or condition	Yes	No	
22.	Is there an emergency power shut-off switch?			
23.	Is there a telephone available for emergency purposes?			
24.	Is there a fire protection system in the computer room?			
25.	Is antistatic flooring installed?			

**Table 2-5 Site Inspection Checklist (Continued)**

Please check either Yes or No. If No, include comment# or date				Comment or Date
26.	Are there any equipment servicing hazards (loose ground wires, poor lighting, and so on)?			
<b>Cooling</b>				
No.	Area or condition	Yes	No	
27.	Can cooling be maintained between 20°C and 55°C (up to 5,000 ft.)? Derate 1°C/1,000 ft. above 5,000 ft. and up to 10,000 ft.			
28.	Can temperature changes be held to 10°C per hour with tape media? Can temperature changes be held to 20°C per hour without tape media?			
29.	Can humidity level be maintained at 40% to 60% at 35°C noncondensing?			
30.	Are air conditioning filters installed and clean?			
<b>Storage</b>				
No.	Area or condition	Yes	No	
31.	Are cabinets available for tape and disc media?			
32.	Is shelving available for documentation?			
<b>Training</b>				
No.	Area or Condition			
33.	Are personnel enrolled in the System Administrator's Course?			
34.	Is on-site training required?			

## Delivery Survey

The delivery survey forms list delivery or installation requirements. If any of the items on the list apply, enter the appropriate information in the areas provided on the form (Figure 2-2).

Special instructions or recommendations should be entered on the special instructions or recommendations form. The following list gives examples of special instructions or issues:

- Packaging restrictions at the facility, such as size and weight limitations
- Special delivery procedures
- Special equipment required for installation, such as tracking or hoists
- What time the facility is available for installation (after the equipment is unloaded)
- Special security requirements applicable to the facility, such as security clearance

**Figure 2-2**      **Delivery Survey (Part 1)**

**ELEVATOR**

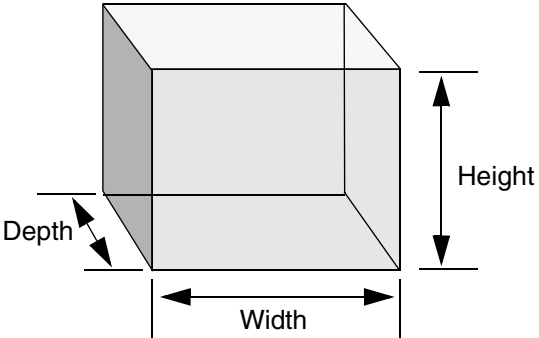
Fill in the following information if an elevator is required to move equipment.

Capacity (lb. or kg) \_\_\_\_\_

Depth \_\_\_\_\_

Height \_\_\_\_\_

Width \_\_\_\_\_



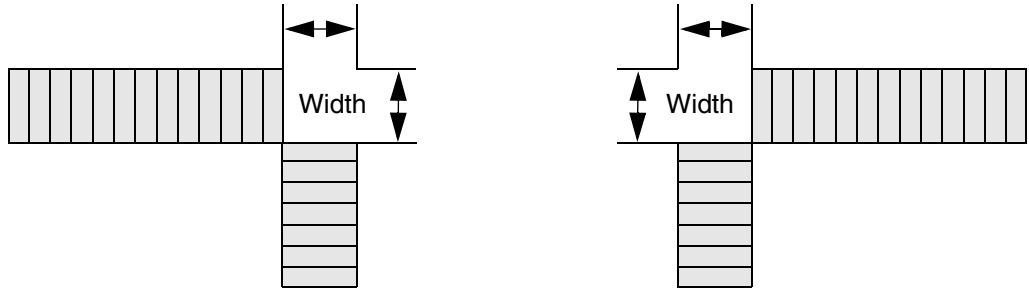
**STAIRS**

Please list number of flights and stairway dimensions.

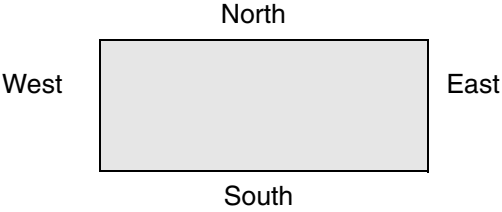
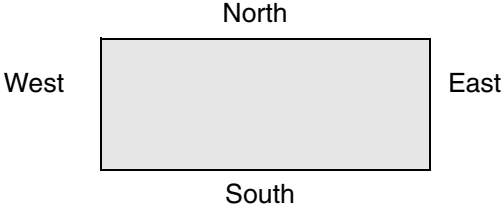
Number of flights \_\_\_\_\_      Number of flights \_\_\_\_\_

Width \_\_\_\_\_      Width \_\_\_\_\_

Width \_\_\_\_\_      Width \_\_\_\_\_



**Figure 2-3 Delivery Survey (Part 2)**

DELIVERY CHECKLIST	
<b>DOCK DELIVERY</b>	
Is dock large enough for a semitrailer? Yes _____ No _____	
Circle the location of the dock and give street name if different than address.	
	
<b>STREET DELIVERY</b>	
Circle the location of access door and list street name if different than address.	
	
List height _____ and width _____ of access door.	
List special permits (if required) for street delivery.	
Permit type:	Agency obtained from:
_____	_____
_____	_____

---

## Information to Collect Before You Contact Support

Before you contact HP support, you should:

- Step 1.** Check information on troubleshooting and attempt to solve the problem. Refer to “Troubleshooting” in the *Operation Guide* for your system, available at <http://docs.hp.com>.
- Note failure symptoms and error indications (LEDs and messages) by checking the SEL and FPL logs

**Information to Collect Before You Contact Support**

- Try to determine precisely what did or did not happen

**Step 2.** Collect the following information:

- The model number of your server (such as, rp4410 or rp4440)
- The product number of your server. This can be found on the identification label, which is found at the front of the unit (typically A9956A, A9951A, and so on)
- The serial number of your server. This can be found on the identification label

**Step 3.** Become familiar with your system configuration:

- Are you using the LAN, RS232, or web interface to monitor the server?
- How many processors, DIMMs, and PCI cards have been installed?
- What versions of processor, memory, and PCI cards are used and where are they installed?
- What accessories are installed?

**Step 4.** Determine the following:

- Which firmware versions are in use?
- When did the problem start?
- Have recent changes been made to the system?
- Which operating system and version is in use?



---

# Glossary

## A-B

**Apparent power** A value of power for AC circuits that is calculated as the product of RMS current times RMS voltage, without taking the power factor into account.

**ASHRAE Standard 52-76** Industry standard for air filtration efficiency set forth by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

**ASL** Above sea level.

**board** A printed circuit assembly (PCA). Also called a card or adapter.

**Btu/h** The abbreviation for British thermal units. The amount of heat required to raise one pound of water one degree Fahrenheit per hour, a common measure of heat transfer rate.

## C

**CompactPCI** The newest specification for PCI-based industrial computers is called CompactPCI. It is electrically a superset of desktop PCI with a different physical form factor. Refer to [http://www.picmg.org/pdf/PICMG3\\_xIntro.pdf](http://www.picmg.org/pdf/PICMG3_xIntro.pdf) for details.

**CFM** The abbreviation for cubic feet per minute, commonly used to measure the rate of air flow in an air conditioning system.

**Chilled water system** A type of air conditioning system that has no refrigerant in the unit itself. The refrigerant is contained in a chiller, which is located remotely. The chiller cools water, which is piped to the air conditioner to cool the space.

## D-K

**Dehumidification** The process of removing moisture from the air within a critical space.

**Derate** To lower the rated capability of an electrical or mechanical apparatus.

**Downflow** Refers to a type of air conditioning system that discharges air downward, directly beneath a raised floor, commonly found in computer rooms and modern office spaces.

**EIA unit** The Electronic Industries Association (EIA) defines this unit of measurement to be 1.75 inches in height. So then, 1U equals 1.75 inches (1U equals 44.45 mm).

**Humidification** The process of adding moisture to the air within a critical space.

**Inrush current** The peak current flowing into a power supply the instant AC power is applied. This peak is usually much higher than the typical input current due to the charging of the input filter capacitors. When switching power supplies are first turned on, they present high initial currents as a result of filter capacitor impedance. These large filter capacitors act like a short circuit, producing an immediate inrush surge current with a fast rise time. The peak inrush current can be several orders of magnitude greater than the supply's typical current.

**KVA** Abbreviation for kilovolt-amperes. (1,000 x volt-amperes).

## L-N

**Latent cooling capacity** An air conditioning system's capability to remove heat from the air.

**Leakage current** A term relating to current flowing between the AC supply wires and earth ground. The term does not necessarily denote a fault condition. In power supplies, leakage current usually refers to the 60 Hertz current, which flows through the EMI filter capacitors that are connected between the AC lines and ground.

**Maximum input current** The operating current of the product equal to the maximum load divided by the minimum input voltage.

**NEBS** All electronic equipment has the potential to interfere with other electronic equipment. Interference can be caused by electromagnetic radiation, the grounding system, the electrical power connection, excessive heat, or blocking the natural airflow, and connecting wires or cables. The FCC (Federal Communications Commission) regulates a portion of this problem through Part 15 of their rules and regulations. Even more stringent than the FCC Part 15 requirements, Network Equipment Building Standards (NEBS) covers a large range of requirements including criteria for personnel safety, protection of property, and

operational continuity. The documents cover both physical requirements including: Space Planning, Temperature, Humidity, Fire, Earthquake, Vibration, Transportation, Acoustical, Air Quality and Illumination; and electrical criteria including: Electrostatic Discharge (ESD), Electromagnetic Interference (EMI), Lightning and AC Power Fault, Steady State Power Induction, Corrosion, DC Potential Difference, Electrical Safety and Bonding and Grounding.

## O-R

**PCA** Abbreviation for Printed Circuit Assembly also referred to as a Printed Circuit Board (PCB).

**PCI** Currently, the most popular local I/O bus, the Peripheral Component Interconnect (PCI) bus was developed by Intel and introduced in 1993.

**PICMG** A consortium of companies involved in utilizing PCI for embedded applications. The PCI Industrial Computer Manufacturers Group (PICMG) controls the PICMG specification.

**Power factor** The ratio of true power to apparent power in an AC circuit. In power conversion technology, power factor is used in conjunction with describing the AC input current to the power supply.

**RMS** Root-mean-square (rms) refers to the most common mathematical method of defining the effective voltage or current of an AC wave. To determine rms value, three mathematical operations are carried out on the function representing the AC waveform: (1) The square of the waveform function (usually a sine wave) is determined. (2) The function resulting from step (1) is averaged over time. (3) The square root of the function resulting from step (2) is found.

## S-T

### Theoretical maximum power consumption

Represents the maximum wattage of a given configuration, assuming worst-case conditions (thermal tolerances, workloads, and so forth) on all system components. It is extremely unlikely that any customer will experience this level of power consumption.

**Tonnage** The unit of measure used in air conditioning to describe the heating or cooling capacity of a system. One ton of heat represents the amount of heat needed to melt one ton (2,000 lbs.) of ice in one hour. 12,000 Btu/hr equals one ton of heat.

**True power** In an AC circuit, true power is the actual power consumed. It is distinguished from apparent power by eliminating the reactive power component that may be present.

**Typical input current** The operating current of the product measured using a typical load and target voltage.

**Typical power consumption** Represents the expected power consumption of a given configuration. The typical value is the approximate power consumption that a customer will most likely experience and can use for power budgeting purposes.

## U-Z

**Vapor seal** A vapor seal is an essential part of preventing moisture infiltration into or migration out of a critical space, such as a data processing center or other room that contains sensitive electronic instrumentation. Essentially, a vapor seal is a barrier that prevents air, moisture, and contaminants from migrating through tiny cracks or pores in the walls, floor, and ceiling into the critical space. Vapor barriers may be created using plastic film, vapor-retardant paint, vinyl wall coverings and vinyl floor systems, in combination with careful sealing of all openings (doors and windows) into the room.

**Watt** A unit of electricity consumption representing the product of amperage and voltage. When the power requirement of a product is listed in watts, you can convert to amps by dividing the wattage by the voltage. (e.g., 1200 watts divided by 120 volts is 10 amps.

**A**

air conditioning  
  system recommendations, 31  
air conditioning ducts, 32  
air distribution system  
  room space return air, 31

**B**

basic air conditioning equipment requirements, 30  
basic air distribution systems, 31

**C**

circuit breaker, 15  
computer room safety  
  fire protection, 23  
cooling requirements, 30

**D**

data communications cables, 29  
dimensions and weights, 13  
ducts, air conditioning, 32

**E**

electrical and environmental guidelines  
  air distribution system, 31  
  computer equipment grounds, 27  
  computer room safety  
    fire protection, 23  
  dust and pollution control, 32  
  electrical conduit ground, 26  
  grounding systems, 26  
  lighting requirements, 24  
  main building electrical ground, 26, 27  
  power distribution safety grounding, 26  
  power panel grounds, 26  
  power quality, 24  
    sources of electrical disturbances, 25  
  system installation guidelines, 29  
electrical specifications, 15  
environmental elements, 30  
  acoustics, 34  
  air conditioning equipment requirements, 30  
  air conditioning recommendations, 31  
  air distribution systems, 31  
  computer room considerations, 30  
  cooling requirements, 30  
  dust and pollution control, 32  
  electrostatic discharge  
    prevention, 34  
  humidity level, 32  
  static protection measures, 34

**F**

facility characteristics, 35  
facility guidelines  
  characteristics, 35  
  floor loading terms, 36  
  floor-plan grid, 38

  operational space requirements, 38  
  typical raised floor site, 36  
  windows, 37  
fire protection, 23  
floor loading  
  raised floor, 35

**G**

grounding systems, 26  
  electrical conduit ground, 26

**H**

humidity level, 32

**K**

Keystone system  
  environmental elements, 30  
  power system protection, 25  
  temperature and humidity specifications, 19  
  typical installation schedule, 41

**M**

main building electrical ground, 26

**N**

noise emission specifications, 21

**P**

power distribution hardware, 25  
power distribution safety grounding, 26  
power distribution system  
  distribution hardware, 25  
power quality, 24  
power system protection, 25

**R**

raised floor  
  ground system, illustrated, 28

**S**

sources of electrical disturbances, 25  
space requirements, 38  
  delivery space requirements, 38  
system installation guidelines, 29  
  data communications cables, 29  
  wiring connections, 29

**T**

temperature and humidity specifications, 19  
typical installation schedule, 41

**W**

wiring  
  connections, 29