Site Planning Guide for Entry-Level Servers Version 1.4

Sun Enterprise™ 250 Server

Sun Fire™ 280R Server

Sun Fire V480 Server

Sun Fire V880 Server

Sun Fire V440 Server

Sun Fire V890 Server

Sun Microsystems, Inc.
www.sun.com

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Contents

Figures

Tables

Preface

This guide is designed to assist Sun Microsystems customers who have purchased Sun entry-level servers and who seek information about the proper way to house the servers in a data center. It provides information about the servers' environmental requirements, power consumption, cooling requirements, electrical specifications, and space requirements after the servers are mounted in Electronics Industries Association (EIA)-compliant cabinets or racks.

The Sun entry-level servers covered in this guide are:

- Sun Enterprise™ 250
- Sun Fire™ 280R
- Sun Fire V480
- Sun Fire V880
- Sun Fire V440
- Sun Fire V890

The material in this guide is correct as of the date of publication. For the most up-to-date information, refer to the Sun Microsystems web site for your product.

Other Resources

This manual is not intended as a comprehensive guide to facility design. Customers planning to construct a new data center should read the *Sun Microsystems Data Center Site Planning Guide* before reading this manual. Some of the material in this manual is summarized from the *Sun Microsystems Data Center Site Planning Guide.*

Another resource for data center design is *Enterprise Data Center Design and Methodology* by Rob Snevely. This is a Sun BluePrints™ book, published by Sun Microsystems Press, a Prentice Hall title. You can find information about this book and other BluePrints books at:

`http://www.sun.com/books/blueprints.series.html`

How This Book Is Organized

Chapter 1 describes a source for industry guidelines for site planning, site planning assistance that is available from Sun, site planning considerations, designing for system configurations, data center location, and planning the route to the data center.

Chapter 2 explains environmental requirements of the data center, including temperature, humidity, acclimitization, cooling and aisle airflow, vibration and shock, contaminants, and fire containment.

Chapter 3 gives information about rackmounting the servers, how to locate cabinets in the data center, and details about Sun cabinets.

Chapter 4 discusses power and cooling issues relating to the servers, including power sources, power constraints, power supplies, and heat output and cooling requirements.

Chapter 5 lists shipping, physical, base system configurations, electrical, environmental, rackmounting, and clearance for service specifications for the servers. It also provides specifications for Sun cabinets.

Chapter 6 provides a site planning checklist that you can use when planning your data center and preparing for system installations.

Accessing Sun Documentation

You can view, print, or purchase a broad selection of Sun documentation, including localized versions, at:

`http://www.sun.com/documentation`

Related Documentation

Application	Title	Part Number
Facility planning	*Sun Microsystems Data Center Site Planning Guide*	805-5863
	Enterprise Data Center Design and Methodology	See BluePrints URL
Configuration	*Sun Enterprise 250 Server Owner's Guide*	805-5160
	Sun Fire 280R Server Owner's Guide	806-4806
	Sun Fire V480 Server Administration Guide	816-0904
	Sun Fire 880 Server Owner's Guide	806-6592
	Sun Fire V440 Server Administration Guide	816-7728
	Sun Fire V890 Owner's Guide	817-3956
Rackmounting	*Sun Enterprise 250 Server Rackmounting Guide*	805-3611
	Sun Fire 280R Server Setup and Rackmounting Guide	806-4805
	Sun Fire V480 Server Setup and Rackmounting Guide	816-0902
	Sun Fire 880 Server Rackmounting Guide	806-6594
	Sun Fire V880 Server Rackmounting Guide for Sun Rack 900	817-2779
	Sun Fire V440 Server Installation Guide	816-7727
	Sun Fire V440 Server 2-Post Rackmounting Guide	817-0952
	Sun Fire V890 Server Rackmounting Guide	817-6264

Application	Title	Part Number
Related Documentation Continued		
Sun cabinets	*Sun Rack 900*	See Sun Rack 900 URL
	Sun Rack 900 Installation Manual	816-6386
	Sun Rack 900 Service Manual	816-6387
	Sun StorEdge Expansion Cabinet Installation and Service Manual	805-3067
	Sun Fire Cabinet Installation and Reference Manual	806-2942
Web sites	Entry-level servers: `http://www.sun.com/servers/entry`	
	Site planning support: `http://www.sun.com/service/support/install/index.html` `http://www.sun.com/service/support/environment`	
	Sun Rack 900: `http://www.sun.com/servers/rack/rack.html`	
	Sun BluePrints documents: `http://www.sun.com/books/blueprints.series.html`	

Third-Party Web Sites

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Site Planning Guide for Entry-Level Servers Version 1.4, part number 816-1613-14

CHAPTER 1

Site Preparation

This chapter provides an overview of the site planning process. It also describes some of the services that are available from Sun to help you plan and monitor your data center. This chapter offers basic information about issues relating to the data center location, system configurations, and the route to the data center.

This manual includes information only about these Sun servers:

- Sun Enterprise™ 250
- Sun Fire™ 280R
- Sun Fire V480
- Sun Fire V880
- Sun Fire V440
- Sun Fire V890

Go to this web site for more information about these servers:

`http://www.sun.com/servers/entry`

Industry Guidelines for Site Planning

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has published guidelines for equipment manufacturers and data center designers to standardize on the following issues relating to a data center site:

- Operating environments for classes of equipment
- Equipment layout for optimum reliability and airflow
- Tests of the operational health of the data center
- Evaluations of equipment installations
- Mechanism for reporting power, cooling, and environmental specifications

These guidelines were developed by an industry consortium, of which Sun is a member. These guidelines are discussed in detail in the 2004 report "Thermal Guidelines for Data Processing Environments," which was generated by the ASHRAE Technical Committee 9.9. For information about ASHRAE and the report, go to:

`http://www.ashrae.org`

Site Planning Assistance From Sun

Sun takes a preemptive approach to maximizing system performance by providing services that can help you to properly evaluate your data center site, and install and configure your systems. With the appropriate Sun℠ Services agreement, you can choose the best services for your installation, which might include the following:

- Sun Enterprise Installation Services
- Sun Environmental Services

Sun Enterprise Installation Services

Using the Sun Enterprise Installation Services methodology, Sun technicians and engineers can help you to develop a stable data center site and equipment installations that provide the foundation for system reliability, availability, and serviceability. Sun Enterprise Installation Services are delivered in these phases:

- **Site audit** - (via telephone) Sun reviews your data center environmental and installation requirements.
- **Installation planning** - (via telephone) Sun and customer plan and document the installation schedule, resources, delivery dates, installation dates, and system setup requirements.
- **System installation specification** - Sun maps out the systems' installation requirements, confirms your installation acceptance criteria, and verifies that preinstallation tasks are complete.
- **Installation and configuration of Sun hardware and software** - Sun performs the following installation tasks:
  - Reviews the packing list
  - Installs all internal and external components
  - Sets SCSI devices for all drives
  - Powers up and tests all hardware components
  - Partitions the operating system disk(s) on defined defaults

- Installs and configures the Solaris™ Operating System as an NFS file server
    - Installs all applicable software patches
    - Configures system hostname, IP address, NIS/NIS+ domain, and netmask, as applicable
    - Adds heterogeneous file systems support
    - Installs and configures CDE or NFS mount if remote
    - Sets up log host and system controller
    - Installs up to three unbundled software products
    - Sets up standard UNIX mail host and default routes
    - Configures as Domain Name Service client
- **Installation verification** - Sun performs level-0 backup of system disk(s) and mails installation data files to appropriate Sun aliases.
- **System turnover** - Sun and customer review the installation and associated documentation, and customer signs off that the installation is acceptable.

For more information about Sun Enterprise Installation Services, go to:

`http://www.sun.com/service/support/install/index.html`

Sun Environmental Services

To help you monitor, analyze, improve, and control environmental conditions in your data center, Sun provides Sun Environmental Services. By assessing your environment and finding potential causes of downtime, Sun can help you maintain the operating conditions in your data center so that your systems can perform optimally. Sun Environmental Services include the following:

- **Environmental System Inspection Services** - Provides you with a detailed evaluation of select Sun machines, outlining possible effects that the physical environment has on system availability. An environmental specialist will collect specific environmental, infrastructure, and planning information regarding your site to identify potential issues that could increase the threat of degraded performance. This service includes an inspection of the data processing area for temperature, humidity, airflow, cabling access to equipment, physical specifications, contamination, cleaning activities, and electrostatic discharge procedures. The result of the inspection is a report that outlines the data, provides recommendations for improvement or further inspection, and gives a summary of Sun data center best practices.
- **Environmental Assessment Services** - Provides a comprehensive evaluation of your data center environment. Unlike the Environmental System Inspection Services, which target specific Sun systems, the Environmental Assessment Services encompasses all systems, regardless of manufacturer, and the entire data

center. By conducting detailed tests, making field observations, and interviewing site personnel, environmental experts focus on conditions that can impact the reliability of your systems, either by determining sources of existing problems or identifying potential susceptibilities before they impact hardware operations. An onsite environmental assessment measures and analyzes temperature, humidity, cleanliness, environmental monitoring and control equipment, hardware placement and configuration, contaminants, and equipment grounding. The results are compiled in a report that includes detailed recommendations for an improved data center environment and system performance.

- **Environmental Monitoring and Remediation Services** - Further environmental services might be recommended as a result of findings in your Assessment Services. Based on your needs, you can choose from a full complement of monitoring and remediation services to help eliminate existing and potential threats to system reliability and uptime.

For more information about Sun Environmental Services, go to:

`http://www.sun.com/service/support/environment`

Site Planning Considerations

Customer facility managers, system administrators, and Sun account managers need to discuss site planning, preparation, and system installation before delivery of the systems. A common understanding of environmental requirements and how the systems will be delivered, configured, installed, and maintained will help to create a suitable facility and successful installation of the servers and related equipment.

However, it is important to plan the data center as a whole and not based solely on shelf-level or cabinet-level calculations of system requirements. There are too many interdependencies in a modern data center that can make simple calculations unreliable. Designs and plans need to be made for the data center as a whole, and all of its equipment, with the recognition that implementing one change in the data center environment can affect many other physical, mechanical, and environmental aspects of the facility.

Factor in requirements of third-party equipment and support equipment in the room. Consider where dense computing locations might have high power and cooling demands that could affect power and environmental constraints. Consider rack positioning and airflow patterns. Ensure that the raised floor space, air conditioning, power supply equipment and generators, and related support equipment meet the demands of all the servers and other mission-critical equipment.

Keep in mind that flexibility, redundancy, and expandability of the site can extend the life of the working environment.

System Configurations

The first step in the installation process is to determine the hardware configuration for each server you plan to install. You can obtain advice about your system configuration from your Sun account manager or Sun authorized sales representative. You can obtain system documentation before receiving your system by downloading product information and manuals from the Web. See “Accessing Sun Documentation” on page xii. Alternatively, you can consult the documentation provided with your systems for information about supported configurations.

In some facilities there will be many different configurations of the same server model; in others, multiple configurations of different server models. Each server should be accounted for separately because each server requires a specific amount of power and a specific amount of cooling. Future server upgrades and other modifications will be easier if you keep a written record of each server’s configuration.

Planning for Maximum System Configurations

It may be prudent to plan your facility using data for maximally configured systems. There are several ways in which maximum system configuration data is useful.

Facility managers can use this data to quickly calculate the most demanding set of conditions for weight, power, and air conditioning load. This data is helpful for planning purposes early in a facility construction cycle.

Many customers buy servers configured for present needs but realize that future demands will require server upgrades. Since the specifics of such upgrades are often difficult to predict, some customers elect to make facility planning decisions based on maximum configuration data from the start. One benefit of this approach is that it minimizes subsequent facility disruptions that might be needed to accommodate upgraded or new systems.

Maximum configuration data also can help you when you select and lay out racks and cabinets. For example, racks planned for high-density servers can be distributed throughout the data center and laid out in hot-aisle/cold-aisle rows to minimize hot spots.

Maximum configuration data can help you determine how to route electrical circuits and plan for power, cooling, and other equipment needed to support a full-capacity data center. In addition, maximum configuration data can help you plan for auxiliary power or backup power, and plan for power grid independence if continued uptime is required.

Planning for Actual System Configurations

Some experts estimate that only half or less of the power, cooling, and other support equipment is used in the data center when systems are originally installed. In addition, experts report that electrical and mechanical equipment can account for nearly two thirds of the initial capital costs of the facility. This results in high up front design and construction costs for electrical and mechanical equipment, and ongoing operating and maintenance costs that are higher than actually needed to support the installed systems. (For in-depth discussion of these topics, see “Data Center Power Requirements: Measurements From Silicon Valley,” J. D. Mitchell-Jackson, J. G. Koomey, B. Nordman, M. Blazek, *Energy-The International Journal*, Vol. 28, No. 8, June 2003, p. 837-850; “Design Guidelines for a High Density Data Center,” R. Hughes, *The Data Center Journal*, Dec. 14, 2003.)

Therefore, some data center designers prefer to build the facility in a way that maximizes expandability and flexibility. Designers estimate initial infrastructure requirements using the actual power, cooling, and environmental specifications that the systems incur when installed. This provides the minimum requirements that the data center must meet. As systems are upgraded or added, power, cooling, and other infrastructure equipment is installed in a modular architecture that supports scalable growth without interruption of data center functions. It is important to design the data center so that it can accommodate infrastructure upgrades without adversely affecting the continuous operation of the installed systems.

When building the data center, the costs of sizing the site for maximally configured systems must be weighed against the costs of sizing the site for actual resources used and adding infrastructure equipment as needed.

Using System Configuration Data

TABLE 5-3 presents some of the components of *sample base configurations* of the servers. There are many more standard and optional components associated with these configurations, depending on what you choose for your servers. Do not use the systems’ *nameplate power ratings* when calculating existing power consumption and heat load. Nameplate ratings indicate the servers’ hardware limits for maximum power draw that the systems can support. Nameplate ratings note higher levels of power consumption than systems require at installation. The additional power capacity is available for system upgrades. Nameplate power ratings are useful if you add components that significantly affect power demands.

Instead, for current data center planning, rely on *measured system configuration data*, which you can obtain from your Sun account manager or Sun authorized sales representative. TABLE 5-4 presents measured power ratings for the sample base configurations of the servers described in this guide.

Data Center Location and Design

Whether a dedicated facility or part of a multipurpose building, the location and design of the data center need special consideration. When determining the location and design of the data center, consider the following issues:

- **Moisture and air leakage** - Ensure that the data center is not located below any room that could cause water or moisture to leak into the data center. Exclude plumbing from the room, except plumbing that supports the fire suppression and heating, ventilation, and air conditioning (HVAC) systems. To prevent air and moisture leakage, do not install windows that open to the outside of the facility.
- **Contaminants** - Isolate the data center from activities that could contaminate the environment. Ensure that the air intake for the data center is clean. Maintain airborne dusts, gasses, and vapors within defined limits for data center environments to minimize their impact on the systems.
- **Access** - Ensure that there is adequate access to the data center from the loading dock, freight elevator, or other equipment entrances.
- **Security** - Provide secure points of entry to the data center so that only the proper personnel have access to the equipment. Equip data center doors with secure locking mechanisms that can remain operational during a power failure.
- **Room temperature and humidity** - Ensure that the data center has the required air conditioning equipment to adequately cool the systems. Install an automatic, online alarm system to notify personnel if temperature or humidity exceeds the specified thresholds.
- **Airflow** - Consider the intake and exhaust airflow of the systems in the data center. Ensure that the airflow in the room facilitates cooling of equipment.
- **Raised flooring** - Design the raised flooring to consolidate cabinets and racks and to maximize access to support equipment and cables.
- **Ceiling height** - Locate the data center in a facility that provides a floor to ceiling minimum height of 8 feet 6 inches (259 cm). This space lets you install a 7-foot (213.4-cm) equipment rack.
- **Aisle space** - Provide adequate room at the front and back of cabinets and racks to allow unobstructed servicing of the systems and clear passage for personnel.
- **Expansion room** - Design the data center in a way that can accommodate future equipment expansion. Include resources that can provide additional power, environmental support, and floor usage.

See the related sections in this guide for further descriptions of these criteria.

Route to the Data Center

Ideally, the data center and loading dock should be located in close proximity. The access allowances for the path from the loading dock to the data center include:

- A minimum 96-inch (243.9-cm) height (greater is recommended)
- A minimum 60-inch (152.4-cm) width (greater is recommended)

Most cabinets and racks ship in their own containers on a pallet. Make sure that the facility loading dock and unloading equipment can accommodate the height and weight of the cabinets, racks, and servers while in their shipping packages. See TABLE 5-1 for shipping specifications for the servers and TABLE 5-11 for shipping specifications for three Sun cabinets.

Inspect all shipping cartons for evidence of physical damage. If a shipping carton is damaged, request that the carrier's agent be present when you open the carton. Save the original shipping containers and packing materials in case you need to store or ship the system.

When you plan your route to the data center, make sure that the boxed cabinets, racks, and servers can fit through doors and hallways, and on elevators. Also make sure that the route floor and elevators can support the weight of the cabinets, racks, and servers. The route to the data center should have minimal ramps, minimal sharp angles, few bumps, and no stairs.

Provide a room that is separate from the data center in which to open equipment cartons and to repack hardware when you install or deinstall the systems. Do not unpack the servers or racks in the data center. Dirt and dust from the packing materials can contaminate the data center environment. See "Acclimatization" on page 16 for further information about moving the systems into the data center.

CHAPTER 2

Environmental Requirements

Computer system reliability is dependent upon a stable environment. The design of the environmental control system for your data center must ensure that each system can operate reliably while remaining within the range of its operating specifications.

Accurate and comprehensive monitoring of environmental support equipment and in-room conditions is extremely important in a sensitive data center environment. The monitoring system should have historical trend capabilities. Analyzing historical trend information is instrumental when determining seasonal changes or other contributing influences. Also, the environmental control system should have critical alarm capabilities. The system must be able to notify the appropriate personnel when conditions move outside of the systems' established operating specifications.

Operating Specifications

TABLE 5-5, TABLE 5-6, TABLE 5-7, and TABLE 5-8 list the environmental specifications for the servers described in this guide. These specifications might seem broad for data center equipment. However, the operating ranges apply to the absolute hardware limits and the extreme ranges should not be considered guidelines for normal, continuous operation. While the servers can operate in diverse locations and within a wide range of environmental conditions, stringent control over temperature, humidity, and airflow is necessary for *optimal* system performance and reliability.

Temperature

An ambient temperature range of 21 to 23 °C (70 to 74 °F) is optimal for system reliability and operator comfort. While most computer equipment can operate within a rather broad range, a temperature level near 22 °C (72 °F) is desirable because it is easier to maintain a safe associated relative humidity level at this temperature. Further, this recommended temperature provides an operational buffer in case the environmental support systems are down.

Air Intake Temperatures

Note that the operating temperature range for the servers is either 5 to 40 °C (41 to 104 °F) or 5 to 35 °C (41 to 95 °F). These temperatures apply to the air taken in by each server *at the point where the air enters the server,* and not necessarily the temperature of the air in the aisles. Ensure that the air intake temperature is within the operating range of the system. See “Equipment Installation Environmental Tests” on page 13.

Aisle Temperatures

Aisle temperatures can give you a first-level alert to conditions in the data center. In a hot-aisle/cold-aisle cabinet layout, verify that the temperatures within the cold aisles are also within the servers’ operating temperature ranges. These measurements are necessary because temperatures in the data center are different depending on where in the room the measurements are taken. The heat load in the data center can vary as a result of the density of heat-producing equipment located within the room. Avoid placing temperature sensors in areas that are exposed to drafts or other uncontrolled airflow. See “Creating a Hot-Aisle/Cold-Aisle Layout” on page 21 and “Facility Environmental Tests” on page 12.

Rate of Change

Also measure the rate of temperature changes within a 60-minute period. Conditions should not be allowed to change by more that 5.5 °C (10 °F) or 10% relative humidity during a 60-minute period. If you detect fluctuations, measure conditions over a 24-hour period and compare results against historical data to analyze trends.

Also avoid cooling *short cycles*, which can occur if perforated tiles or grilled tiles are placed between the air conditioners and the nearest heat-producing equipment. If tiles are laid out in that way, cold air returns to the air conditioner without circulating through the equipment. The air conditioner might register that temperatures in the room are cooler than is actually the case. The air conditioner might cycle out of its cooling mode while temperatures in the room still call for cooler air.

Humidity

Relative humidity (RH) is the amount of moisture in a given sample of air at a given temperature in relation to the maximum amount of moisture that a sample could contain at the same temperature. A volume of air at a given temperature can hold a certain amount of moisture. Because air is a gas, it expands as it is heated. As air gets warmer, its volume increases and the amount of moisture it can hold increases, thus causing its relative humidity to decrease.

Ambient relative humidity levels between 45% and 50% are most suitable for safe server operations. This optimal range also provides the greatest operating time buffer in the event of an environmental control system failure.

Data center equipment is particularly sensitive to high humidity levels. When relative humidity levels are too high, water condensation can occur, which can lead to hardware corrosion problems.

Further, maintaining a relative humidity level between 45% and 50% helps avoid system damage or temporary malfunctions caused by intermittent interference from electrostatic discharge (ESD), which occurs when relative humidity is too low. Electrostatic discharge is easily generated and less easily dissipated in areas where the relative humidity is below 35%, and becomes critical when relative humidity drops below 30%.

Though the 20% to 80% RH operating specifications for the servers are wide, conditions should be maintained near the optimal relative humidity levels. Extremes within the 20% to 80% RH range can lead to unacceptable conditions. For instance, if very high temperatures are maintained with very high humidity levels, condensation can occur, which can cause corrosive equipment damage. If very low temperatures are maintained with very low humidity levels, even a slight rise in temperature can lead to unacceptably low relative humidity levels.

It is also imperative that sensors on humidifiers are calibrated correctly. If one unit is calibrated to add humidity, and an adjacent unit is calibrated to remove humidity, energy is wasted and an unacceptable environment can occur.

Troubleshooting Environmental Conditions

The temperature and humidity in the data center have a direct relationship to the proper functioning of the installed systems. Data center managers need to be proactive by continually monitoring data center conditions. Regularly scheduled temperature and humidity measurements are one way that data center managers can troubleshoot environmental conditions.

In the ASHRAE report, “Thermal Guidelines for Data Processing Environments” (you can find this report at `http://www.ashrae.com`), three types of data center temperature and humidity tests are suggested:

- Facility environmental tests
- Equipment installation environmental tests
- Equipment failure environmental tests

These tests are described in the following sections.

Facility Environmental Tests

Facility environmental tests are designed to measure ambient temperature and humidity throughout the data center in order to avoid environmental-related equipment problems. These measurements provide an overall assessment of the facility and ensure that the temperature and humidity of air in the cold aisles are within the systems’ recommended operating ranges.

Knowing the temperature and humidity of the facility also gives you a general assessment of how the HVAC systems are functioning and how much cooling capacity is available to expand the facility.

To measure the ambient temperature and humidity of the data center, follow these guidelines:

- Place sensors in cold aisles, where cold air outlets provide conditioned air to the systems. Hot-aisle measurements will be typically out the systems’ recommended operating ranges and therefore are not a valid indication of the required temperature and humidity levels.
- Place sensors 10 to 30 feet (3 to 9 m) apart, or in front of every fourth rack in the aisle.
- Place sensors in the middle of the aisle, between the rows of racks.
- Place sensors 4.9 feet (1.5 m) above the tiled floor.

These measurements will provide you with a detailed and representative profile of the temperature and humidity of air in the cold aisles. By continually monitoring temperature and humidity within the aisles, you can guard against changes that could affect the systems' optimal environmental ranges. If any measurements are outside of the systems' optimal operating ranges, data center managers must identify the source of, and correct, the problem.

It is also important to measure the temperature and humidity of the return air in front of the HVAC systems. If the return air is below the ambient temperature of the cold aisles, it might mean that cold-aisle air is short cycling, that is, returning to the HVAC units before filtering through the systems.

Equipment Installation Environmental Tests

Equipment installation environmental tests are used to ensure that systems are properly installed and laid out within the facility. These tests measure the temperature and humidity of the air immediately in front of the systems or cabinets. Unacceptable environmental conditions can occur if racks of systems have mixed airflow patterns, if cabinets are not properly vented, or if high-density systems are laid out too closely, causing hot spots.

To measure the temperature and humidity in front of the installed systems, follow these guidelines:

- Take measurements in front of the top, middle, and bottom system in the rack.
- Take measurements at the mid-point vertically and horizontally at the front of each of the three systems.
- Take measurements at 2 inches (5 cm) from the front of the three systems.
- If there are three or fewer systems in the rack, take measurements at 2 inches (5 cm) from the front mid-point of each system.

For example, if there are ten servers in the rack, measure the temperature and humidity at the mid-point of the servers at 2 inches (5 cm) from the front of the first, fifth, and tenth server, bottom to top, in the rack.

All temperature and humidity measurements should be within the systems' recommended operating ranges. If the environmental levels are outside of these ranges, data center managers should reevaluate airflow patterns and equipment layout, and determine whether the required cold air is available to the systems.

Equipment Failure Environmental Tests

Equipment failure environmental tests can help you determine whether the system failure was due to environmental conditions. These tests are similar to the equipment installation environmental tests, except that temperature and humidity measurements are isolated to the failed system. These tests can help you determine whether the air intake to the system is within the system's recommended temperature and humidity ranges.

To measure the temperature and humidity of air in front of a failed system, follow these guidelines:

- For a 1RU to 3RU system, take measurements at three points midway vertically and horizontally at 2 inches (5 cm) from the front of the system. This provides one horizontal row of three measurement points.
- For a 4RU to 6RU system, take measurements at six points at 2 inches (5 cm) from the front of the system. Divide the six points into two rows of three points each. Center each row of points vertically and horizontally in front of the system.
- For a 7RU or larger system, take measurements at nine points at 2 inches (5 cm) from the front of the system. Divide the nine points into three rows of three points each. Center each row of points vertically and horizontally in front of the system.
- For systems with a localized air inlet area, take measurements in a circular grid pattern, with the number of points dependent on the size of the inlet area.
- For a system installed in a cabinet, take measurements in front of the system with the cabinet doors in their normal operating position, that is, either with the cabinet doors opened or closed.

All temperature and humidity measurements should be within the recommended operating range of the system. If all measurements are within this range, environmental conditions are probably not the cause of the system failure.

Cooling and Aisle Airflow

Data centers have different cooling and airflow capacities, often depending on when the data center was built and the requirements it was designed to meet. When designing a data center, you should consider the facility's heating, ventilation, and air conditioning (HVAC) capacity so that equipment in fully populated cabinets and racks can be adequately cooled. The air conditioners need to be set accurately with a sensitivity of +/- 1 ^{o}C (+/- 2 ^{o}F).

Calculating Cooling Requirements

Typically, a cabinet footprint requires 12 square feet (1.115 sq. m). However, cooling measurements are calculated using the gross square footage required by the cabinets or racks, which is not just the area where cabinets or racks are located. The measurement includes aisles and areas where power distribution, ventilation, and other facility equipment is located. Gross square footage is estimated to be 20 square feet (1.858 sq. m) per cabinet or rack.

For example, a data center may provide 100 watts per square foot of cooling capacity using air conditioners. Based on 100 watts per square foot and 20 square feet (1.858 sq. m) per cabinet, each cabinet is allowed a cooling capacity of 2000 watts (100 watts x 20 sq. ft.) or 2 kW. Remember, 2 kW per cabinet gross square footage in a data center is only an example. Some cabinets might require 3 kW or more of cooling capacity. Some dense computing equipment, such as blade servers in a rack, can require 10 kW or higher of cooling per rack. See "Heat Output and Cooling" on page 37 for more information about cooling requirements.

Measuring Aisle Airflow Speed

It is also important to consider the intake and discharge airflow required to cool the systems. All of the servers described in this guide draw in ambient air for cooling from the front and discharge heated exhaust air to the rear. Ensure that the air conditioning equipment can adequately move air down the aisles so that heated air does not flow over the cabinets and racks to the front of the systems.

Measure airflow speed in different zones of the floor to determine whether the existing airflow pressure is sufficient to provide the necessary conditioned air to the systems. Take measurements every 13 to 16 feet (4 to 5 m). Measurements taken at lesser distances might not detect a significant pressure difference. A typical airflow speed ranges between 10 to 13 feet (3 to 4 m) per second.

Adequate airflow speed will facilitate the required delivery of conditioned air down the cold aisles and to the systems. If airflow pressure is inadequate, the conditioned air will heat up before it reaches the areas in need of cooling. While an office environment might require only two air changes per hour, the high-density heat load in a data center can require as many as 30 air changes per hour.

See "Cabinet Location" on page 21 for information about how to locate cabinets and racks in the data center to ensure proper aisle airflow.

Acclimatization

When determining how long you must allow a system to acclimatize after delivery to the data center, and before power can be applied to the system without causing damage, you should compare the temperature and humidity of the environment in which the system had been stored to the conditions in the data center. Equipment damage can occur if the *rate* of temperature or humidity change is too great.

The maximum positive or negative temperature gradient that is recommended for multilayered boards is approximately 2 ^{o}C (4 ^{o}F) per hour. The same consideration applies to humidity; it is best to have a slow rate of change.

If it is necessary to compensate for significant temperature or humidity differences between the systems and the data center, place the systems, in their shipping containers, in a location that has a similar temperature and humidity environment as the data center. Wait at least 24 hours before removing the systems from their shipping containers to prevent thermal shock and condensation.

Vibration and Shock

Make sure that your installation adequately protects equipment from excessive vibration and shock. When installing systems of different types in the same cabinet or rack, be sure that the overall vibration and shock characteristics do not exceed those of the system with the lowest vibration and shock specifications.

For example, if you are installing two different types of systems in the same cabinet, and one system can tolerate 4 g peak shock, and the other system can tolerate 10 g peak shock, make sure that vibration of your cabinet does not exceed 4 g peak shock. TABLE 5-7 and TABLE 5-8 describe vibration and shock specifications for the systems covered in this guide.

Contaminants

The impact of contaminants on sensitive electronic equipment is well known, but the most harmful contaminants are often overlooked because they are so small. Most particles smaller than 10 microns are not visible to the naked eye. Yet it is these particles that are most likely to migrate to areas where they can do damage.

Some sources of contaminants include the following:

- **Personnel activity** - Human movement within the computer room is probably the single greatest source of contamination in an otherwise clean room. The opening and closing of drawers or hardware panels or any metal-on-metal activity can produce metal filings. Simply walking across the floor can agitate settled contaminants making them airborne and potentially harmful.
- **Hardware movement** - Hardware installation or reconfiguration involves a great deal of onfloor and subfloor activity, and settled contaminants can be disturbed, forcing them to become airborne.
- **Stored items** - Storage and handling of unused equipment or supplies are also a source of contamination. Cardboard boxes or wooded skids shed fibers when moved or handled.
- **Cleaning activity** - Many chemicals used in office cleaning solutions can damage electronic equipment. Gases from these products or direct contact with the hardware can cause component failure. Solutions that can damage hardware include chlorine-based products, phosphate-based products, bleach-enriched products, petrolchemical-based products, and floor strippers or reconditioners.

Fire Containment

A fire in the data center can cause catastrophic damage to the equipment and the building structure. Take the following precautions to minimize the risk of a fire:

- **Separate the data center from other building offices using fire-resistant walls** - Ensure that the walls are fire-rated and constructed of noncombustible or limited-combustible materials.
- **Isolate rooms within the data center with firewalls** - Extend the firewalls from the subfloor to the structural ceiling.
- **Install an automatic fire detection system** - Use a fire detection system that is sensitive to smoke and other products of combustion rather than solely temperature in the room. Also install manual fire alert stations and provide fire extinguishers throughout the data center.

- **Avoid unnecessary storage** - Do not store combustible materials in the data center. Remove packing materials and other unnecessary materials as soon as possible.
- **Check the electrical system insulation periodically** - Breakdowns in insulation and the resultant short circuiting can lead to intense heat that can melt materials or cause a fire.
- **Check heat recoils on the air conditioners periodically** - If left unused for a long time, these recoils can collect layers of dust that can ignite when the unit is turned on.
- **Inspect the data center perimeter** - Look for any openings that could expose the data center to hazardous areas.
- **Create detailed disaster response plans** - Train personnel how to respond in the event of a fire.

The cabinet or rack must meet Underwriters Laboratories, Inc. and TUV Rheinland of N.A. requirements for fire containment. See the server documentation for specific requirements.

CHAPTER 3

Rackmounting the Systems

The Electronics Industries Association (EIA) establishes standards for cabinets and racks intended for use with computers and other electronic equipment. All of the servers discussed in this guide are designed for rackmounting in cabinets or racks that comply with the EIA 310D standard.

Cabinet and Rack Terminology

The terms *cabinet* and *rack* are sometimes used interchangeably, which is incorrect. Computer cabinets are fitted with doors and side panels, which may or may not be removable, and are available in a very wide variety of sizes and colors. Most cabinets provide connections for electrical power. Some cabinets provide fans and baffles designed to move cooling air in a specified direction and often, at a specified rate. Others provide electromagnetic interference (EMI) and radio frequency interference (RFI) shielding to meet standards established by various regulatory agencies.

Cabinets enclose a rack, which is a frame that provides a means for mounting electronic equipment. Racks can also stand alone and do not require the doors, panels, and other integrated equipment that comes with cabinets. Racks come in different types. One type consists of two vertical rails, which are not enclosed by cabinet doors and panels. Another, and more common type, consists of four vertical rails, which may or may not be enclosed by cabinet doors and panels.

You can mount the Sun Fire V480 server and the Sun Fire V440 server in either a 4-post rack or a 2-post rack, using optional two-post rackmounting kits. The racks used for mounting the other servers covered in this guide consist of four vertical mounting rails. The servers are attached to mounting hardware, and the mounting hardware is secured to the rack's front and back vertical rails. FIGURE 3-1 shows Sun servers mounted in a cabinet and rack.

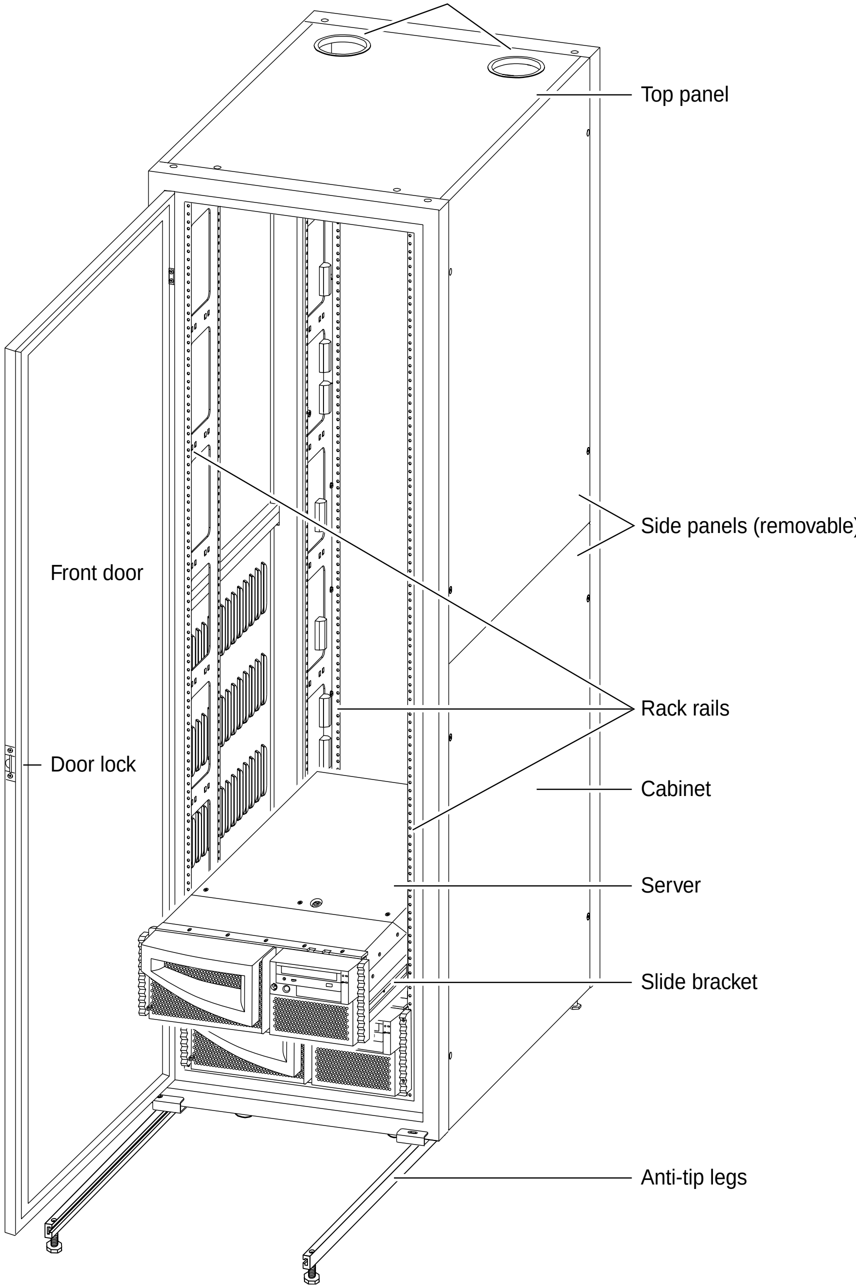


FIGURE 3-1 Systems Mounted in a Cabinet and Rack

Cabinet Location

There are several matters to consider when planning the location of rackmounted systems in a data center. Service access to the rackmounted systems is usually from the front and cable management from the rear. For future planning, consider whether the location and space provisions for your equipment provide a reasonable amount of room for expansion.

When planning the floor space utilization of your facility, be aware that a typical cabinet occupies 12 square feet (1.115 sq. m) of floor space, which corresponds to three tiles, each tile measuring 2 x 2 feet (0.61 x 0.61 m). When room for aisles, power distribution equipment, air conditioners, and other equipment is included, floor space utilization can equal 20 square feet (1.858 sq. m), or five tiles, per cabinet.

Creating a Hot-Aisle/Cold-Aisle Layout

Because of the front-to-back airflow of the systems, the ideal placement of the cabinets and racks have the systems installed front to front and back to back. This configuration is referred to as a *hot-aisle/cold-aisle layout*.

A hot-aisle/cold-aisle layout enables cool air to flow through the aisles to the systems' front air intake and enables heated air to flow away from the systems' back exhaust to the air conditioner return ducts. This layout eliminates direct transfer of hot exhaust air from one system into the intake air of another system. FIGURE 3-2 illustrates a hot-aisle/cold-aisle layout.

Form rows of racks or cabinets perpendicular to air conditioners. This formation facilitates an unobstructed flow of heated air down the aisles to the air conditioner return ducts. Heated air must not be forced to travel over or between the cabinets to get to the air conditioner return ducts. Doing so could heat the air in the cold aisles. Ensure that any free-standing equipment does not allow air to flow between the hot and cold aisles.

A cold aisle has perforated floor tiles or grates that enable cold air to rise from the raised floor. A hot aisle has no tiles or grates so that hot air and cold air do not mix. Seal cable cutouts in both hot aisles and cold aisles to increase underfloor pressure and to eliminate cold or hot air redirection. To further optimize the airflow in hot and cold aisles, install blanking panels at the front of all unused cabinet spaces so that hot air does not recirculate to the systems' cold air inlet.

To avoid hot spots, avoid placing cabinets housing high-density servers too close together within the same area of the data center. Locate high-density servers, which emit a high heat load, where the static pressure under the raised flooring is greatest, and therefore cool airflow from the tiles is greatest.

There may be some equipment in the data center that does not employ the front-to-back airflow through the system. To maximize the benefits of a hot-aisle/cold-aisle configuration, keep equipment with the differing airflow directions together in a separate part of the data center. Direct all exhaust air to a hot aisle.

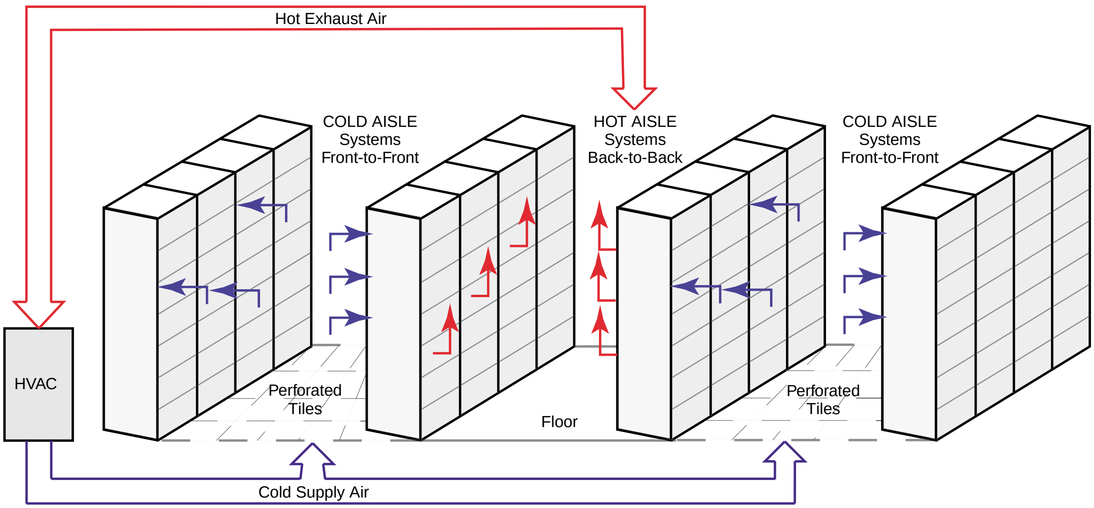


FIGURE 3-2 Hot-Aisle/Cold-Aisle Layout

Determining Aisle Clearances

To allow for installation, removal, or maintenance of a server, a clear service area must be maintained in front and in back of the cabinet or rack. At a minimum, this area should extend 3 feet (0.9 m) forward from the front of the rack (4 feet/1.2 m for a rackmounted Sun Fire V880 or V890 server) and 3 feet on either side of the server when it is fully extended from the rack. You should also keep at least a 3-foot clearance at the rear of the cabinet or rack to allow for service and maintenance.

There are no side clearance requirements for the cabinets or racks due to the front to back airflow of the servers. If cabinets are located closely side by side, leave a minimum 1.5-feet (0.46-m) space between every five cabinets for access to the rear of the cabinets or to another aisle. If the cabinets have side panels and you believe that at some time you might need to remove them, then position the cabinets with at least 2 feet (0.6 m) of space on either side.

Determining Aisle Pitch

Aisle spacing is determined when you establish the *aisle pitch* for the cabinet locations. Aisle pitch is the distance from the center of one cold aisle to the center of the next cold aisle either to the left or right. Data centers often use a seven-tile aisle pitch. This measurement allows two 2 x 2 foot (0.61 x 0.61 m) floor tiles in the cold aisle, 3 feet (0.9 m) in the hot aisle, and a 42-inch (1-m) allowance for the depth of the cabinet or rack. FIGURE 3-3 illustrates a seven-tile aisle pitch.

If you use floor tiles other than 2 x 2 feet (0.61 x 0.61 m), you will need to determine a different aisle pitch from this generally accepted design. For larger cabinets or cabinets with high-power servers, you may need to use an eight-tile pitch to facilitate airflow.

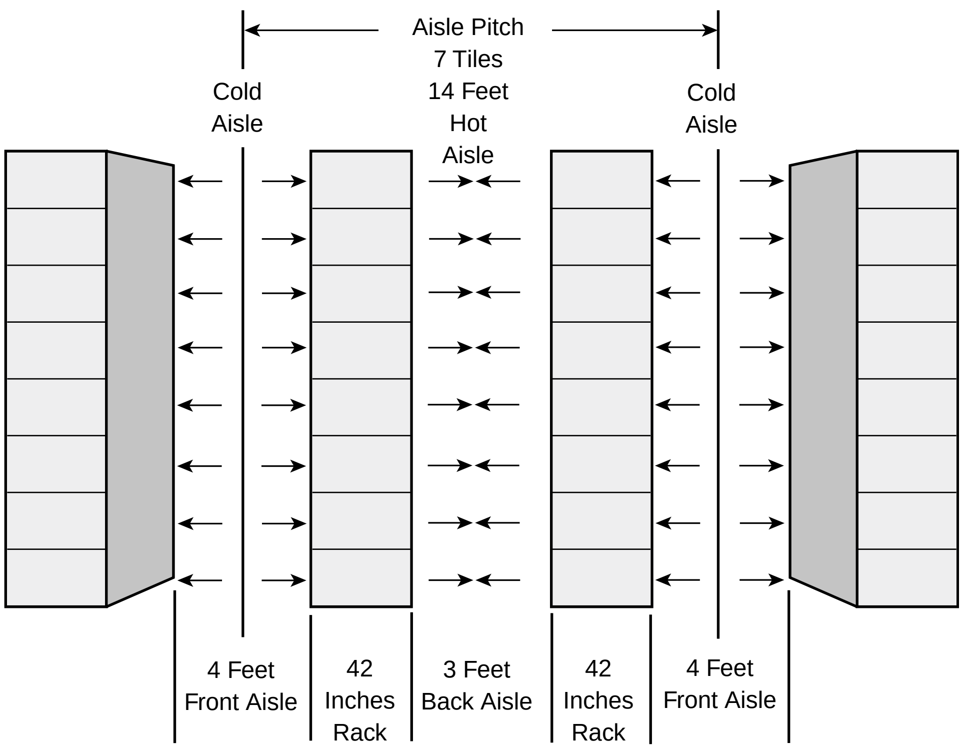


FIGURE 3-3 Seven-Tile Aisle Pitch

Sun Cabinets

Sun Microsystems offers EIA 310D-compliant cabinets for mounting the servers. Sun cabinets are designed and tested with some configurations of Sun equipment. Any limitations on mixing Sun products in the cabinets are also known and documented. Your system may require a rackmount kit to enable installation into certain cabinets or racks. Contact your Sun account manager or Sun authorized sales representative for details.

The Sun Rack 900 cabinet family is among the newer cabinets from Sun. This cabinet provides an industry-standard 35.4-inch (90-cm) depth and is designed to hold both servers and storage products. This flexibility can help you to better utilize floor space and to reduce administrative costs because you can mount a greater variety of products in the Sun Rack 900 than was previously possible with other cabinets.

The Sun Rack 900 provides you with options for power, front door, filler panels, cables, and so forth, which enable you to configure the cabinet to fit your needs. The optional power distribution system (PDS) consists of two independently powered sequencers. Each power sequencer provides two power outlet strips, each with 24 outlets, providing 48 outlets to systems. The PDS does not use any rack units (RU) of available product space when installed in the Sun Rack 900. A vertical cable management bracket, when used with the cable management arms, keeps cables organized for easy tracing and mobility.

The Sun Rack 900 can be shipped to customers with systems preintegrated and racked into place. For information about products qualified by Sun to rackmount in the Sun Rack 900, go to:

`http://www.sun.com/servers/rack/approved.html`

For further information about the Sun Rack 900, go to:

`http://www.sun.com/servers/rack/rack.html`

Another Sun cabinet is the Sun StorEdge Expansion Cabinet. See the *Sun StorEdge Expansion Cabinet Installation and Service Manual* for information about this enclosure. A third cabinet is the Sun Fire Cabinet. See the *Sun Fire Cabinet Installation and Reference Guide* for information. These documents are available at:

`http://www.sun.com/documentation`

TABLE 5-11, TABLE 5-12, and TABLE 5-13 contain specifications for the three cabinets.

Cabinet, Rack, and Server Dimensions

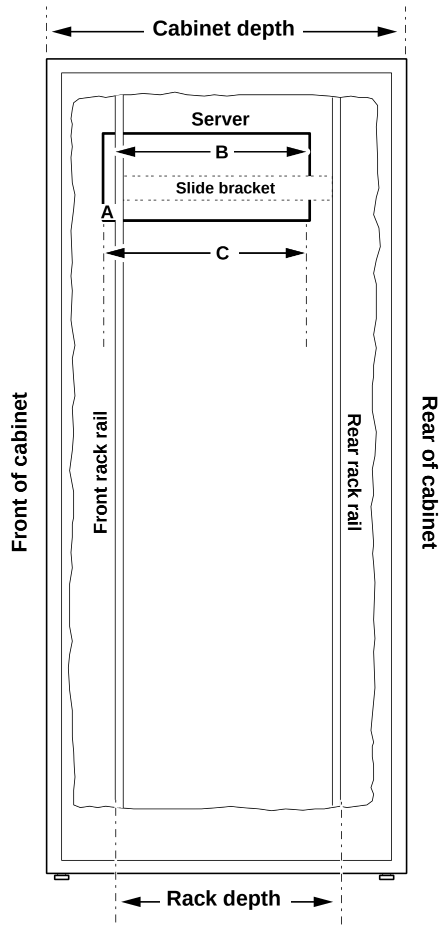
Because the terms *rack* and *cabinet* are sometimes used interchangeably, much confusion exists about the proper way to measure cabinets and the proper way to measure racks. Cabinets are traditionally referred to by their external dimensions. Most newer cabinets have depths of 32 or 36 inches (81.28 or 91.44 cm). In most cases, the rack depth is 4 to 6 inches (10.6 to 15.25 cm) less than the external cabinet depth.

To measure the rack depth, measure the horizontal distance from the forward-most part of the front rail to the rear-most point of the rear rail. TABLE 5-10 provides the depths of the servers, the rackmounting depth ranges for the servers when using Sun rackmounting equipment, and the recommended cabinet depths.

Cabinet manufacturers typically recommend 34-inch (86.36-cm) or greater cabinets for use with servers that have an average depth of 28 inches (71.12 cm), and 39-inch (99.06-cm) or greater cabinets for use with servers that have an average depth of 33 inches (83.82 cm). The approximate 6-inch (15.24-cm) space at the back between the server and back cabinet door allows for cable management, airflow, and service access.

Rack widths are specified in the EIA 310D standard by the full front panel width that the rack can accommodate. Available widths include 19 inches (48.26 cm), 23 inches (58.42 cm), 24 inches (60.96 cm), and 30 inches (76.2 cm). All servers covered by this guide are designed for mounting in 19-inch (48.26-cm) wide racks that comply with the EIA 310D standard. However, you can rackmount some of the servers in racks of other widths using adapter hardware. Contact your Sun account manager or Sun authorized sales representative for further information.

FIGURE 3-4 illustrates the proper way to measure cabinet, rack, and server depths.



A = Depth of the server in front of the front rack rail
B = Depth of server from the forward-most part of the front rack rail to the rear-most part of the server
C = Total depth of server

FIGURE 3-4 Measuring Cabinet, Rack, and Server Depths

Rack Units

Be certain that there is sufficient vertical mounting height for the servers and other equipment you plan to mount in the rack. The vertical mounting space in EIA 310D-compliant racks is defined in *modular units* (U). Common industry nomenclature also uses the term *rack units* (U or RU).

One rack unit is equal to 1.75 inches (4.45 cm). The rack rail holes on a standard rack are arranged in sets of three holes, spaced vertically 5/8, 5/8, and 1/2 of an inch apart. The number and type of systems you can mount in a rack is determined by the number of rack units the systems require, as well as the amount of power available to the systems.

FIGURE 3-5 shows some of the features, the dimensions, and rack unit spacing of an EIA 310D-compliant cabinet and rack. TABLE 5-9 gives the number of rack units that each system requires.

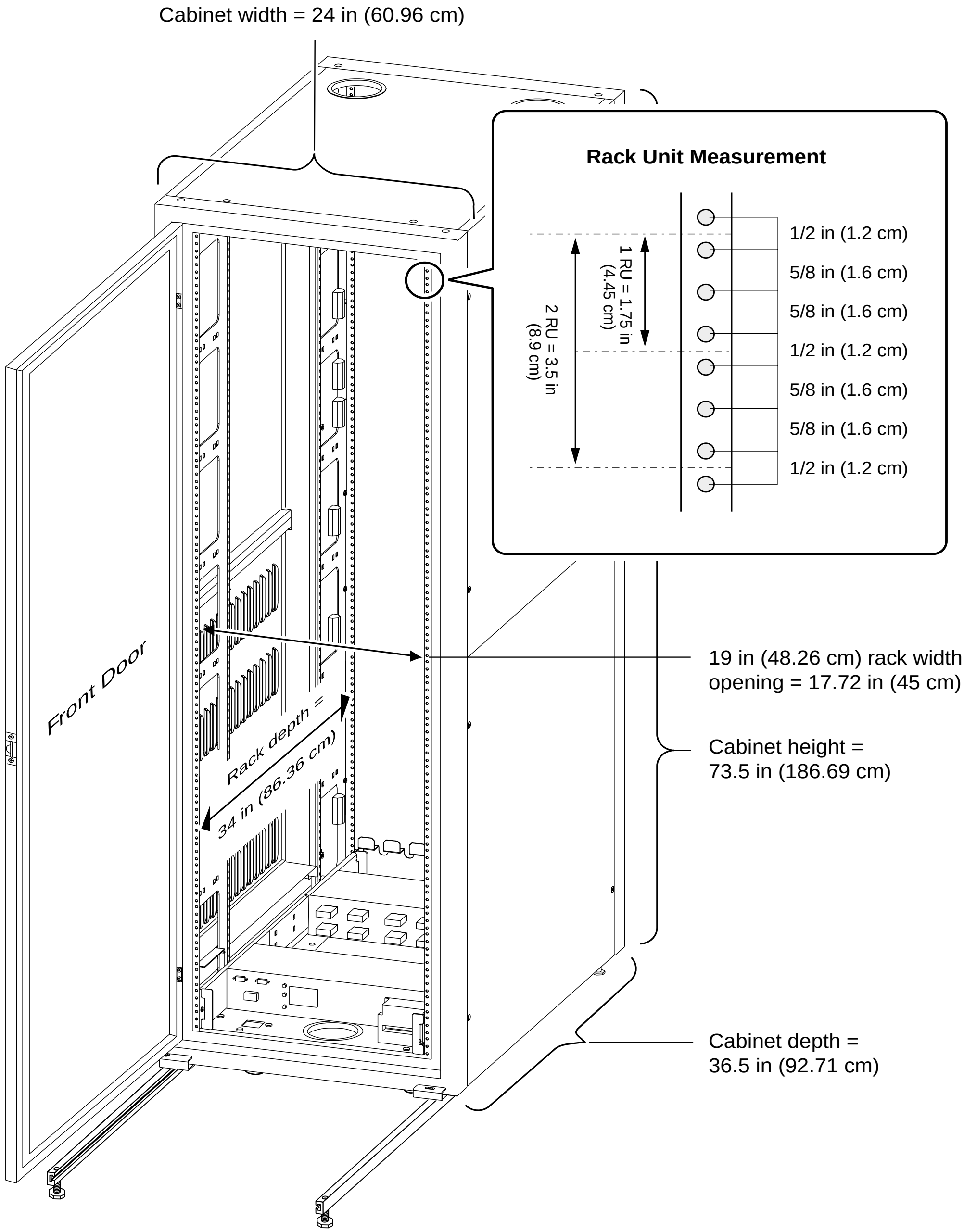


FIGURE 3-5 EIA 310D-Compliant Cabinet and Rack

Other Cabinet and Rack Features

Cabinet Doors and Panels

Determine which cabinet doors and panels you will need to properly mount equipment at your site. The Sun servers discussed in this guide come with lockable doors or panels. Most cabinets, however, are available with locking doors, which provide an additional measure of security. Some cabinets have rear doors and some have side panels. Typically, if several cabinets are located in a row, side panels are only attached to the two end units.

All of the servers described in this guide draw in ambient air for cooling from the front and discharge heated exhaust air to the rear. Make sure that any front or back cabinet doors are at least 63% open to allow adequate airflow. This can be accomplished by removing the doors, or by ensuring that the doors have a perforated pattern that provides at least 63% open area. In addition, maintain a minimum 3.8-cm (1.5-inch) clearance between the systems and any front or back cabinet doors.

Load Capacity

Calculate the weight of the servers and other equipment you plan to mount in a given cabinet or rack. Then, be sure that this weight falls within the load capacity of the enclosure. The approximate weights of systems covered in this manual are provided in TABLE 5-2. The load capacities of the Sun Rack 900, Sun StorEdge Expansion Cabinet, and Sun Fire Cabinet are listed in TABLE 5-12.

It is important to determine whether the strength of the data center floor is sufficient to support the weight of all the cabinets and racks that you will install, after they are fully populated with systems and other equipment. Consult a qualified structural engineer to evaluate the locations of the cabinets and racks in the data center.

EMI and RFI Requirements

All Sun entry-level servers comply with all electromagnetic interference (EMI) and radio frequency interference (RFI) shielding requirements for a computer room environment. The servers do not rely on the cabinet for EMI or RFI shielding. Other equipment that you include in the cabinet might depend on the cabinet for proper EMI or RFI shielding. The Sun cabinets achieve this by retaining EMI and RFI within the cabinet. It is a best practice to house devices that radiate EMI or RFI in cabinets that are separate from the server cabinets.

The servers comply with the following U.S. Federal Communications Commission (FCC) Part 15 Rules for Class A or Class B operation. Class A operation describes equipment operated in a commercial environment; Class B operation describes equipment operated in a residential environment.

- Sun Enterprise 250 - Class B
- Sun Fire 280R - Class A
- Sun Fire V480 - Class A
- Sun Fire V880 - Class A
- Sun Fire V440 - Class A
- Sun Fire V890 - Class A

Power Sequencers

Power sequencers are devices that provide sequential power to the available outlets on the sequencer. When power is available, not every outlet may be powered on at the same time. For instance, if the sequencer has 10 outlets, outlet 1 may be powered on, then one second (arbitrary number) later, outlet 2 is powered on, and then another second later outlet 3 is powered on.

The Sun cabinets come with two power sequencers, which enable AC input fault tolerance when each sequencer is connected to a different power source. In this way, the sequencers can provide some power redundancy for the servers. In addition, the power sequencers provide a limited amount of power conditioning. See TABLE 5-13 for the power sequencer specifications.

Be sure that there is a sufficient number of power outlets within reach of the power cords for each server and for the cabinet's power cords. See TABLE 5-2 for the lengths of the power cords for the servers. Do not use extension cords or plug-in power strips in your installation.

For the Sun Fire V890 server, use the 10-amp power cords that are supplied with the server. The V890 server uses 200 to 240 VAC input only. See Chapter 4 for further information about the power requirements of the servers.

Stabilization

Each cabinet or rack must be bolted securely to the floor or be equipped with extendable anti-tip legs in order to keep it from tipping forward when a server or other equipment is extended out the front of the rack. For added stability, extend only one system out of the rack at a time. Always install systems in the rack from the bottom up to help stabilize the cabinet.

Tools Required for Rackmounting the Systems

You will need some of the following tools to rackmount the systems:

- Phillips No. 1, No. 2, and No. 3 screwdrivers
- Flat-blade No. 1 and No. 2 screwdrivers
- Allen and adjustable wrenches
- Needlenose pliers
- Spirit level
- Electrostatic discharge (ESD) wrist strap
- ESD mat
- GL-8 Genie Lift (recommended for larger systems)

Rackmounting Guidelines

Follow these guidelines when rackmounting a server:

- Consult the appropriate rackmounting documentation before attempting to install any server into a rack.
- Ensure that the floor can support the weight of people performing the lift, plus the weight of the server, the rack, and any other nearby equipment.
- Before attempting to install a server into a rack, fully extend the anti-tip legs or bolt the cabinet to the floor.
- Two persons are needed to install these servers into a rack:
  - Sun Enterprise 250
  - Sun Fire 280R
  - Sun Fire V480
  - Sun Fire V440

- Four persons (or a suitable lift) are needed to install these servers into a rack:
  - Sun Fire V880 server
  - Sun Fire V890 server
- Remove some of the components of the larger servers to make the lift easier.
- Install the heaviest servers and storage devices in the lowest position in the rack.
- Install the remaining servers from the lowest system upward into the rack.

CHAPTER 4

System Power and Cooling Requirements

This chapter provides information about important power issues relating to your servers. Your server documentation provides more detailed power information.

The design of your electrical power system must ensure that adequate, high-quality power is provided to each server and all peripherals at all times. Power system failures can result in system shutdown and possible loss of data. Further, computer equipment that is subject to repeated power interruptions or fluctuations experiences a higher component failure rate than equipment that has a stable power source.

Power Requirements

Each system, when properly configured and installed, must receive sufficient incoming AC power to supply all installed components. The data center should be able to provide a stable, dual-current path to the installed equipment. In addition, the power infrastructure must be designed to maintain system uptime even during disruption of the main power source. It is important to use dedicated AC breaker panels for all power circuits that supply power to your systems. The power system should be designed to provide sufficient redundancy, eliminate all single points of failure, and allow the isolation of a single system for testing or maintenance without affecting the power supplied to other systems.

Power Sources

It is important to secure multiple sources of power when possible. Ideally, multiple utility feeds should be provided from different substations or power grids. This setup provides power redundancy and backup.

The systems provide AC input fault tolerance via redundant power supplies. Therefore, it is prudent to attach to each primary power supply a common power cord from one power grid that can supply power to all systems, and to attach another power cord from a different power grid to the redundant supplies. If a primary power grid goes offline, a backup power grid will provide power to the redundant supplies to keep the systems operating. See "Power Supplies" on page 36 for information about power supply redundancy.

For the Sun Fire V890 server, use the 10-amp power cords that are supplied with the server. The V890 server uses 200 to 240 VAC input only.

UPS and Backup Generator

Using an online uninterruptible power supply (UPS) and a backup power generator provides a good strategy for obtaining an uninterruptible source of power. The online UPS filters, conditions, and regulates the power. It protects the systems from fluctuating voltages, surges and spikes, and noise that may be on the power line. The battery backup for the UPS should be capable of maintaining the critical load of the data center for a minimum of 15 minutes during a power failure. This is typically sufficient time to transfer power to an alternate feed or to the power generator.

The backup power generator should be able to carry the load of both the computer equipment and the supporting heat, ventilation, and air conditioning (HVAC) equipment. The generator should include dual power distribution switch gear with automatic transfer switching. To offset the possibility of a generator failure, power system designers often include a temporary generator for secondary backup.

Grounding

Grounding design must address both the electrical service and the installed equipment. A properly designed grounding system should have as low an impedance as is practically achievable for proper operation of electronic devices as well as for safety. It is important to use a continuous, dedicated ground for the entire power system to avoid a ground differential between various grounds. Grounding design in the United States should comply with Article 250 of the U.S. National Electrical Code unless superseded by local codes. Use an antistatic wrist strap when working inside the chassis.

All properly installed Sun systems are grounded through the power cable. However, there are reasons for installing an additional mechanism to equalize potential. Problematic or deficient conduits can negatively affect another system, especially with respect to the possibility of spreading voltages. Additional grounding points help to avoid leakage current, which prevent system malfunctions. Therefore, additional cables might be used to connect Sun systems and cabinets to the data center’s potential equalization rail. Enlist the aid of a qualified electrician to install grounding cables.

Emergency Power Control

A primary power switch that can disconnect all electronic equipment in the data center is specified by NFPA 70 and NFPA 75 (National Fire Protection Association specifications) at each point of entry to the data center. The primary switch should disconnect power to all computer systems and related electronic equipment, HVAC equipment, UPS, and batteries. Multiple disconnects for separate parts of the power systems are also acceptable, but in both cases, the switches must be unobstructed and clearly marked.

Power Constraints

All servers covered by this guide are shipped with a sufficient number of power supplies to provide all power needed by all Sun supported configurations.

Sun does not test many third-party products that are compatible with Sun servers. Therefore, Sun makes no representations about those products or about the power requirements for products not supplied by Sun.

Power constraints can occur in two areas:

- Total AC power consumption
- Current limit of the AC power outlet

To maintain a safe facility, you must ensure that the AC current draw does not exceed the maximum current limit for your power outlet. In the United States and Canada, the maximum is 80% of the outlet’s total capacity, which is 12 amps for 15-amp circuits and 16 amps for 20-amp circuits, and so forth. For areas outside of the United States and Canada, contact local agencies for information about local electrical codes.

See TABLE 5-4 for maximum input current and power consumption for the servers.

Power Supplies

Each server covered by this guide is shipped by Sun with one or more power supplies, which are sufficient to support the maximum configuration of the server.

The systems provide "N+1" power supply redundancy to maintain system uptime. An N+1 redundant power supply configuration does not add to the power capacity of the systems. "N" represents the number of power supplies needed to power a fully configured system. The "1" means that there is one additional power supply in the system to handle the load if a supply fails. When the system is operating normally, all of the power supplies are turned on, even the redundant supplies.

The redundancy configurations of the systems are as follows:

- **1+1**, One supply needed to power the system and one backup supply
  - 250 server
  - 280R server
  - V480 server
  - V440 server
- **2+1**, Two supplies needed to power the system and one backup supply
  - V880 server
  - V890 server

In a 1+1 configuration (that is, two power supplies are installed, each capable of providing enough power for the entire system), both supplies are turned on and are delivering power. Each supply delivers approximately 50% of the power needed by the system. If one supply fails, the supply that is still online will deliver 100% of the power needed to keep the system running.

In a 2+1 configuration (that is, three power supplies are installed, with two power supplies delivering enough power for the entire system), all three power supplies are turned on and are delivering power. Each supply delivers approximately 33% of the power needed by the system. If one supply fails, the supplies that are still online will each provide 50% of the power needed to keep the system running.

Most power supplies cannot support the maximum values on all outputs at the same time because that would exceed the total power supply output capacity. The load must be distributed among the outputs in a way that does not exceed their maximum values or the total output capacity of the power supply.

The servers have built-in protection against exceeding the output capacity of the power supply configuration. Be sure to consult the server documentation to learn how the servers will react during a power overload.

PCI Bus Power

The PCI slots in the Sun servers comply with PCI Local Bus Specification Revision 2.1. The PCI bus in each server is designed to provide 15 watts of power multiplied by the number of PCI slots in the PCI chassis. Thus, a four-slot PCI chassis has a total of 60 watts of power available. These 60 watts can be used in any manner that conforms to the PCI standard. A single PCI slot can support a card that requires up to 25 watts. Here are some examples of how you might populate a four-slot PCI chassis:

- **Example 1** - You install four 15-watt cards. These four 15-watt cards would use up all of the 60 watts of available power in the PCI chassis. They would also occupy all four of the available PCI slots.
- **Example 2** - You install two 22-watt cards plus one 15-watt card. This combination of cards would use 59 watts of the 60 watts available. In all probability, you would have to leave the fourth slot empty in this example, unless you could find a PCI card that required only 1 watt.

Heat Output and Cooling

Servers and related equipment generate a considerable amount of heat in a relatively small area. This is because every watt of power used by a system is dissipated into the air as heat. The amount of heat output per server varies, depending on the system configuration. See TABLE 5-4 for heat output measurements for the servers.

The heat load in a data center is seldom distributed uniformly and the areas generating the most heat can change frequently. Further, data centers are full of equipment that is highly sensitive to temperature and humidity fluctuations. See TABLE 5-5 for the servers' temperature and humidity specifications.

Proper cooling and related ventilation of a server within a cabinet is affected by many variables, including the cabinet and door construction, cabinet size, and thermal dissipation of any other components within the cabinet. Therefore, it is the responsibility of the data center manager to ensure that the cabinet's ventilation system is sufficient for all the equipment mounted in the cabinet.

Do not use the servers' nameplate power ratings when calculating the servers' heat release. The purpose of the nameplate power ratings is solely to indicate the servers' hardware limits for maximum power draw.

Chassis Airflow

The flow of air through the servers is essential to the proper cooling of the servers. Even though the data center air may be at a safe and steady temperature at one location, the temperature of the air entering each server is critical. Problems sometimes arise for these reasons:

- One server is positioned so that its hot exhaust air is directed into the intake air of another server, thus preheating the intake air of the second server.
- Servers are sometimes mounted in cabinets that restrict airflow excessively. This might occur because the cabinets have solid front or rear doors, inadequate plenums, or they might have cooling fans that work against the fans in the servers themselves.
- A server might be mounted in a cabinet above a device that generates a great amount of heat.

All of the servers described in this guide draw in ambient air for cooling from the front and discharge heated exhaust air to the rear. The servers require that the front and back cabinet doors to be at least 63% open for adequate airflow. This can be accomplished by removing the doors, or by ensuring that the doors have a perforated pattern that provides at least 63% open area. In addition, maintain a minimum of 1.5-inch (3.8-cm) clearance between the systems and front and back doors of a cabinet.

The servers are equipped with fans that route cool air throughout the chassis. As long as the necessary air conditioning is provided in the data center to dissipate the heat load, and sufficient space and door openings are provided at the front and back of the servers, the fans will enable the rackmounted servers to work within the temperature specifications for systems in operation. See TABLE 5-5 for temperature specifications. See “Cabinet Location” on page 21 for information about recommended placement of cabinets and racks to optimize proper aisle airflow.

Units of Measurement

A standard unit for measuring the heat generated within, or removed from, a data center is the British Thermal Unit (Btu). The heat produced by electronic devices such as servers is usually expressed as the number of Btu generated in an hour (Btu/hr).

Watts (W) is also a term used to express heat output and cooling. One watt is equal to 3.412 Btu/hr. For example, if you use 100 watts of power, you generate 341.2 Btu/hr.

Air conditioning capacity is also measured in Btu/hr or watts. Large air conditioning systems are rated in tons. One ton of air conditioning is a unit of cooling equal to 12,000 Btu/hr or 3517 watts.

Determining Heat Output and Cooling

TABLE 5-4 lists the minimum, typical, and maximum heat output and cooling requirements for base configurations of the servers. These specification are the *measured power ratings*, which are calculated for the base server configurations as defined by Sun and listed in TABLE 5-3. Use the nameplate ratings only as a references to the servers' hardware limits that could accommodate future components and not to calculate the servers' current power and cooling requirements.

In addition to the heat load generated by the servers, some cabinets include fans, power sequencers, and other devices that generate heat. Be sure to obtain the heat output values of these devices from your cabinet supplier. Also, when calculating data center cooling requirements, be sure to include heat dissipation for all equipment in the room.

To determine the heat output and cooling requirements of the rackmounted servers, add the Btu or watts for each server in the rack. For example, if one server is putting out 1000 Btu/hr (293 watts) and another one is putting out 2000 Btu/hr (586 watts), the total heat generated is 3000 Btu/hr (879 watts). The air conditioning equipment then should be properly sized to cool at least 3000 Btu/hr (879 watts) to accommodate these two systems.

If you only have wattage measurements and want to obtain the equivalent Btu rating, multiply the total wattage by 3.41 to obtain the Btu/hr. To calculate tons of air conditioning, multiply the total wattage by 0.000285.

See "Calculating Cooling Requirements" on page 15 for an example of how to estimate cooling requirements based on the square footage used by the cabinets and racks in the data center.

Using Rack Location Units to Determine Heat Output and Cooling

In the book *Enterprise Data Center Design and Methodology* by Rob Snevely (available at `http://www.sun.com/books/blueprints.series.html`) the concept of using *rack location units* (RLUs) to determine heat output and cooling requirements in the data center is discussed. A rack location is the specific location on the data center floor where services that can accommodate power, cooling, physical space, network connectivity, functional capacity, and rack weight requirements are delivered. Services delivered to the rack location are specified in units of measure, such as watts or Btus, thus forming the term *rack location unit*.

Since today's data centers house hundreds or thousands of systems with widely varying power and cooling requirements, RLUs can help you determine where greater or less power and cooling services are needed. RLUs can also help you determince how to locate the racks to maximize services. Using square footage calculations for power and cooling assumes that power and cooling loads are the same across the entire room. Using RLUs lets you divide the data center into areas that need unique power and cooling services.

To determine RLUs for heat output and cooling, you must add together the heat output and cooling requirements for all systems installed in the rack. Then assess the RLUs for adjacent racks. For example, suppose you had 24,000 square feet of space in the data center. You might have a 12,000-square foot area where 600 PCs are outputing 552,000 Btu / hour and needing 46 Btu / hour of cooling per square foot. Another 6000-square foot area might contain 48 severs outputting 1,320,000 Btu / hour and needing 220 Btu / hour of cooling per square foot. A third 6000-square foot area might contain 12 high-end servers outputting 972,000 Btu / hour and needing 162 Btu / hour of cooling per square foot.

Using a square footage calculation for this example yields a cooling requirement for all three sections of 2,844,000 Btu / hour, or 118.5 Btu / hour of cooling per square foot. This would exceed the 46 Btu / hour cooling needed by the PCs, but it is much too little cooling capacity required for both server areas. Knowing the RLUs for power and cooling enable the data center manager to adjust the physical design, the power and cooling equipment, and rack configurations within the facility to meet the systems' requirements.

CHAPTER 5

System Specifications

This chapter includes shipping, physical, configuration, electrical, environmental, rackmounting, and cabinet specifications for the following Sun systems:

- Sun Enterprise 250
- Sun Fire 280R
- Sun Fire V480
- Sun Fire V880
- Sun Fire V440
- Sun Fire V890

Shipping Crate Specifications

Dimensions and weights are estimates based on fully configured systems, and are dependent on specific system configurations.

TABLE 5-1 Shipping Crate Specifications for Sun Systems

	250	280R	V480	V880	V440	V890
Height	35.75 in 90.80 cm	17.25 in 43.80 cm	23.75 in 60.90 cm	43.69 in 110.97 cm	21.13 in 53.65 cm	43.69 in 110.97 cm
Width	18 in 45.72 cm	23.63 in 60.02 cm	24 in 60.96 cm	25 in 63.50 cm	24 in 60.96 cm	25 in 63.50 cm
Depth	34 in 86.36 cm	37 in 93.98 cm	31.50 in 80.01 cm	37.50 in 95.25 cm	32.25 in 81.91cm	37.50 in 95.25 cm
Weight	150 lb 68.04 kg	100 lb 45.37kg	150 lb 68.04 kg	320 lb 145 kg	120 lb 54.45 kg	320 lb 145 kg
On Pallet	Yes	No	Yes	Yes	Yes	Yes

Physical Specifications

TABLE 5-2 Physical Specifications for Sun Systems

	250	280R	V480	V880	V440	V890
Height	18.1 in 46.0 cm	6.95 in 17.65 cm	8.75 in 22.23 cm	28.1 in 71.4 cm	6.85 in 17.40 cm	28.1 in 71.4 cm
Width	10.3 in 26.2 cm	17.25 in 43.81 cm	17.5 in 44.6 cm	18.9 in (tower) 48.0 cm (tower) 17.25 in (rack) 43.81 cm (rack)	17.48 in 44.40 cm	18.9 in (tower) 48.0 cm (tower) 17.25 in (rack) 43.81 cm (rack)
Depth[1]	28.8 in 73.2 cm	29.12 in 73.80cm	24 in 61 cm	32.9 in 83.6 cm	25 in 63.5 cm	32.9 in 83.6 cm
Weight[2]	118 lb 53 kg	73 lb 33 kg	97 lb 44 kg	288 lb 131 kg	82 lb 37 kg	288 lb 131 kg
Power Cord Length	8.2 ft 2.5 m	6.56 ft 1.99 m	8.2 ft 2.5 m	8.2 ft[3] 2.5 m	8.2 ft 2.5 m	8.2 ft[4] 2.5 m

1 The depth given does not include any I/O or power connectors, or any cable management features.

2 Weights are estimates based on fully configured systems, and are dependent on specific system configurations.

3 Three 2.75-m (9-ft) cords are provided in the Sun Fire V880 rackmounting kit, which extend the original 2.5-m (8.2-ft) power cord lengths to 5.25 m (17.2 ft).

4 Three 2.75-m (9-ft) cords are provided in the Sun Fire V890 rackmounting kit, which extend the original 2.5-m (8.2-ft) power cord lengths to 5.25 m (17.2 ft).

Base System Configurations

These are examples of *possible* base system configurations and do not represent all configurations available. There are many other components that are included within the systems that qualify them as minimum, typical, and maximum configurations. For complete system configuration information, see your Sun account manager or Sun authorized sales representative.

TABLE 5-3 Base Configurations for Sun Systems

	Minimum	Typical	Maximum
250	1 400-MHz CPU 512-Mbyte memory 1 36-Gbyte drive 1 DVD drive 1 PCI card	2 400-MHz CPUs 1-Gbyte memory 2 36-Gbyte drives 1 DVD drive 2 PCI cards	2 400-MHZ CPUs 2-Gbyte memory 6 36-Gbyte drives 1 DVD drive 4 PCI cards
280R	1 1.2-GHz CPU 1-Gbyte memory 1 73-Gbyte drive 1 DVD drive 1 PCI card	2 1.2-GHz CPUs 2-Gbyte memory 2 73-Gbyte drives 1 DVD 2 PCI cards	2 1.2-GHz CPUs 8-Gbyte memory 2 73-Gbyte drives 1 DVD 4 PCI cards
V480	2 1.05-GHz CPUs 4-Gbyte memory 2 36-Gbyte drives 1 DVD drive 1 PCI card	4 1.05-GHz CPUs 8-Gbyte memory 2 36-Gbyte drives 1 DVD drive 3 PCI cards	4 1.05-GHz CPUs 16-Gbyte memory 2 36-Gbyte drives 1 DVD drive 6 PCI cards
V880	2 1.05-GHz CPUs 4-Gbyte memory 6 73-Gbyte drives 1 DVD drive 1 PCI card	4 1.05-GHz CPUs 8-Gbyte memory 6 73-Gbyte drives 1 DVD drive 5 PCI cards	8 1.05-GHz CPUs 32-Gbyte memory 12 73-Gbyte drives 1 DVD drive 9 PCI cards
V440	2 1.062-GHz CPUs 4-Gbyte memory 4 36-Gbyte drives 1 DVD drive 1 PCI card	4 1.062-GHz CPUs 8-Gbyte memory 4 36-Gbyte drives 1 DVD drive 3 PCI cards	4 1.28-GHz CPUs 16-Gbyte memory 4 36-Gbyte drives 1 DVD drive 6 PCI cards
V890	4 1.2-GHz CPUs 16-Gbyte memory 6 73-Gbyte drives 1 DVD drive 1 PCI card	4 1.2-GHz CPUs 16-Gbyte memory 6 73-Gbyte drives 1 DVD drive 1 PCI card	8 1.2-GHz CPUs 32-Gbyte memory 6 73-Gbyte drives 1 DVD drive 3 PCI cards

Electrical Specifications

TABLE 5-4 Electrical Specifications for Sun Systems

	250	280R	V480	V880	V440	V890
Nominal Frequencies	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz
Nominal Voltage Range	100 to 240 VAC auto ranging	100 to 240 VAC auto ranging	100 to 240 VAC auto ranging	100 to 240 VAC auto ranging	100 to 240 VAC auto ranging	200 to 240 VAC auto ranging
AC Operating Range	90 to 264 Vrms 47 to 63 Hz	90 to 264 Vrms 47 to 63 Hz	90 to 264 Vrms 47 to 63 Hz	90 to 264 Vrms 47 to 63 Hz	90 to 264 Vrms 47 to 63 Hz	180 to 264 Vrms 47 to 63 Hz
Max Current AC RMS[1]	3.1A @ 120 VAC	7.5A @ 120 VAC	10.0A @ 120 VAC	12.0A @ 120 VAC	7.7A @ 120 VAC	8.0 A @ 200 VAC
	1.6A @ 240 VAC	3.7A @ 240 VAC	5.0A @ 240 VAC	6.0A @ 240 VAC	3.65A @ 240 VAC	6.7 A @ 240 VAC
AC Power Consumption[2]						
Min	133W	305W	617W	1050W	360W	1183W
Typ	224W	418W	1023W	1440W	570W	1183W
Max	358W	750W	1100W	2115W	650W	2108W
Nameplate	600W	890W	1440W	2880W	925W	3200W
Heat Dissipation and Cooling[3]						
Min	454 Btu/hr	1041Btu/hr	2106 Btu/hr	3584Btu/hr	1229 Btu/hr	4037 Btu/hr
Typ	765 Btu/hr	1427 Btu/hr	3491 Btu/hr	4778 Btu/hr	1945 Btu/hr	4037 Btu/hr
Max	1222 Btu/hr	2560 Btu/hr	3754 Btu/hr	7218 Btu/hr	2218 Btu/hr	7194 Btu/hr
Nameplate	2048 Btu/hr	3038 Btu/hr	4915 Btu/hr	9829 Btu/hr	3157 Btu/hr	10,912 Btu/hr

1 For the 250, 280R, V480, and V440 systems, the specifications refer to total input current required for a single AC inlet when operating with a single power supply. The second power supply is the redundant element. For the V880 and V890 systems, the specifications refer to total input current required for each AC inlet as two power supplies are required to operate the systems. The third V880 and V890 power supplies are the redundant elements.

2 These specifications are calculated using the base system configurations listed in TABLE 5-3.

3 These specifications are calculated using the base system configurations listed in TABLE 5-3.

Environmental Specifications

TABLE 5-5 Environmental Specifications for Sun Systems in Operation

	250, V480, V880, V890	280R, V440
Temperature[1] **Allowable**	41 to 95 ºF 5 to 35 ºC	41 to 104 ºF 5 to 40 ºC
Recommended	70 to 74 ºF 21 to 23 ºC	70 to 74 ºF 21 to 23 ºC
Relative Humidity (RH) Noncondensing Allowable	20% to 80% 27 ºC max wet bulb	20% to 80% 27 ºC max wet bulb
Recommended	45% to 50%	45% to 50%
Altitude	0 to 10,000 ft 0 to 3000 m	0 to 10,000 ft 0 to 3000 m

1 The front and back doors of the cabinet must be at least 63% open for adequate airflow.

TABLE 5-6 Acoustic Specifications for Sun Systems in Operation

	Acoustics Rating
250	6.5 bels
280R	6.9 bels
V480	6.7 bels
V880	6.7 bels
V440	6.2 bels
V890	6.7 bels

TABLE 5-7 Vibration Specifications for Sun Systems in Operation

	Maximum Vibration Rating[1]
250	0.2 g peak (swept sine) 0.0002 g^2 / Hz (random); vertical axis only (castered configuration); vertical and horizontal axis (foot glide configuration)
280R	0.0002 g^2 / Hz (random), flat from Z-axis only
V480	0.0001 g^2 / Hz (random), flat from Z-axis only
V880	Deskside: 0.0002 g^2 / Hz (random) Rackmounted: 0.00015 g^2 / Hz (random)
V440	0.0001 g^2 / Hz (random)
V890	Deskside: 0.0002 g^2 / Hz (random) Rackmounted: 0.00015 g^2 / Hz (random)

1 Measured at 5 to 500 Hz for swept sine.

TABLE 5-8 Shock Specifications for Sun Systems in Operation

	Maximum Shock Rating[1]
250	4 g peak
280R	3 g peak
V480	3 g peak
V880	Deskside: 4 g peak Rackmounted: 3 g peak
V440	3 g peak
V890	Deskside: 4 g peak Rackmounted: 3 g peak

1 Measured at 11 milliseconds half-sine pulse.

Rackmounting Specifications

TABLE 5-9 Rack Units Required by Sun Systems

	Rack Units Required per System for Mounting
250	6U
280R	4U
V480	5U
V880	17U
V440	4U
V890	17U

TABLE 5-10 Typical Rack and Cabinet Depths Used by Sun Systems

	System Depth[1]	Rackmounting Depth Range[3]	Cabinet Depth
250	27.1 in[2] 68.8 cm	27.5 to 35.5 in 69.85 to 90.17 cm	34 in or greater 86 cm or greater
280R	27.25 in 69.21 cm	29.5 to 35.5 in 75.95 to 90.17 cm	34 in or greater 86 cm or greater
V480	24.0 in 61.0 cm	23 to 34.5 in 58.42 to 87.63 cm	28 in or greater 71 cm or greater
V880	32.90 in 83.60 cm	34 to 36 in 86.36 to 91.44 cm	39 in or greater 99 cm or greater
V440	24.0 in 61.0 cm	23 to 34.5 in 58.42 to 87.63 cm	28 in or greater 71 cm or greater
V890	32.90 in 83.60 cm	34 to 36 in 86.36 to 91.44 cm	39 in or greater 99 cm or greater

1 The depth given does not include any I/O or power connectors, or any cable management features.

2 Depth is 28.8 in (73.2 cm) including the power supply handle.

3 The rack depth range is for systems using Sun rackmounting equipment. (Rackmounting hardware is designed to fit a range of different cabinet depths.)

Sun Cabinet Physical Specifications

TABLE 5-11 Physical Specifications for Crated Cabinets

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet	Sun Rack 900
Height	80 in 203 cm	80 in 203 cm	80 in 203 cm
Width	42 in 107 cm	43 in 109 cm	43 in 109 cm
Depth	47 in 120 cm	47 in 120 cm	48 in 122 cm
Weight	524 lb 238 kg	558 lb 253 kg	530 lb 240 kg

TABLE 5-12 Physical Specifications for Cabinets in Operation

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet	Sun Rack 900
Height	73.5 in 186.7 cm	75 in 191 cm	73.75 in 187 cm
Width	24 in 61 cm	24 in 61 cm	23.6 in 60 cm
Nominal Rack Opening	17.72 in 45 cm	17.72 in 45 cm	17.72 in 45 cm
Depth	36 in 91 cm	36 in 91 cm	35.4 in 90 cm
Weight[1]	350 lb 159 kg	325 lb 147 kg	400 lb 181 kg
Load Capacity[2]	1300 lb 589 kg	1200 lb 544 kg	1200 lb 544 kg
Usable Rack Units	36	32	38

1 This specification is the weight of the cabinet and two power sequencers only. The total weight of the cabinet also includes the systems and other equipment it houses.

2 This capacity is for a fully configured cabinet.

TABLE 5-13 Cabinet Power Sequencer Specifications

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet	Sun Rack 900
AC Voltage Rating	200 to 240 VAC	200 to 240 VAC	200 to 240 VAC
Frequency Range	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Max Current	24A @ 240 VAC	24A @ 240 VAC	32A @ 208 VAC
Max Power Capacity[1]	5.7 kW	5.7 kW	7.6 kW
Required Power Receptacles	2-NEMA L6-30R (U.S.)	NEMA L6-30R (U.S.)	4-NEMA L6-20R (U.S.)
	2-IEC309 32A (International)	IEC309 32A (International)	4-IEC309 16A (International)

1 This is the theoretical maximum power capacity of the cabinet. This number should *not* be used to calculate power and cooling requirements for your installation. Use the combined power consumption figures of the equipment installed in the cabinet instead. See TABLE 5-4.

TABLE 5-14 Clearance Specifications for Servicing the Rackmounted Sun Systems[1]

	250, 280R, V480 V440	V880, V890
Front	36 in 91.44 cm	48 in 121.92 cm
Rear	36 in 91.44 cm	36 in 91.44 cm
Right	36 in 91.44 cm	36 in 91.44 cm
Left	36 in 91.44 cm	36 in 91.44 cm
Top	36 in 91.44 cm	36 in 91.44 cm

1 These specifications refer to systems that are fully extended from the rack.

CHAPTER 6

Site Planning Checklist

TABLE 6-1 organizes the site planning tasks into a checklist that you can use during the site planning process.

TABLE 6-1 Site Planning Checklist

Requirement	Completed	Task
Configuration	Yes__No__	Have you determined the hardware configuration for each system?
	Yes__No__	Have you determined the type and number of cabinets and racks you need?
	Yes__No__	Have you determined how you will populate each rack?
	Yes__No__	Have you determined which external peripherals, such as terminals, monitors, keyboards, SCSI devices, and so forth, the systems require?
Environmental	Yes__No__	Does the data center environment meet the system specifications for temperature and humidity?
	Yes__No__	Have you determined the thermal load, heat dissipation, and air conditioning requirements of all equipment in the data center?
	Yes__No__	Can you maintain the data center environment when certain failures occur, such as power failure, air conditioning unit failure, or humidity control unit failure?
	Yes__No__	Is fire suppression and alarm equipment installed?
Power	Yes__No__	Have you determined the maximum power requirements of the systems?
	Yes__No__	Have you considered using an alternate source of power for grid independence and backup power for the local sub-station?
	Yes__No__	Have you installed a UPS?
	Yes__No__	Do you have sufficient power receptacles and circuit breakers for each system and its peripherals?

TABLE 6-1 Site Planning Checklist *(Continued)*

Requirement	Completed	Task
	Yes__No__	Are the power receptacles within 15 feet (4.6 m) of the racks or within 6 feet (1.8 m) of a standalone system?
	Yes__No__	Have you installed and labeled the circuit breakers?
Physical	Yes__No__	Does the facility's loading dock meet standard common carrier truck requirements? If not, have you made other arrangements for unloading the racks and systems, such as providing a fork lift?
	Yes__No__	Are pallet jacks or carts available to move the systems and racks from the loading dock to the computer room?
	Yes__No__	Will the equipment fit through the access route and into the computer room?
	Yes__No__	Have you calculated the weight of each rack with all the equipment installed within it?
	Yes__No__	Is the data center floor able to support the weight of the systems and racks?
	Yes__No__	Have you established where you will locate each rack on the data center floor?
	Yes__No__	Are the systems and racks positioned so that the heated exhaust air of one system does not enter the air inlet of another system?
	Yes__No__	Is there sufficient room around the racks for system access and maintenance?
Miscellaneous	Yes__No__	Are there sufficient number of people available to unload, unpack, and install the systems into the racks?
	Yes__No__	Have system administrators and service technicians enrolled in appropriate training courses to upgrade their skills, as necessary?
	Yes__No__	Have you acquired all the hardware needed to set up the systems and racks?
	Yes__No__	Do you have the documents required to install the systems into the racks?