# HP Modular Cooling System 200/100 Site Preparation Guide

**Abstract**

This document provides site preparation guidance for the MCS-200/100.

Part Number: 749810-001
June 2014
Edition: 1

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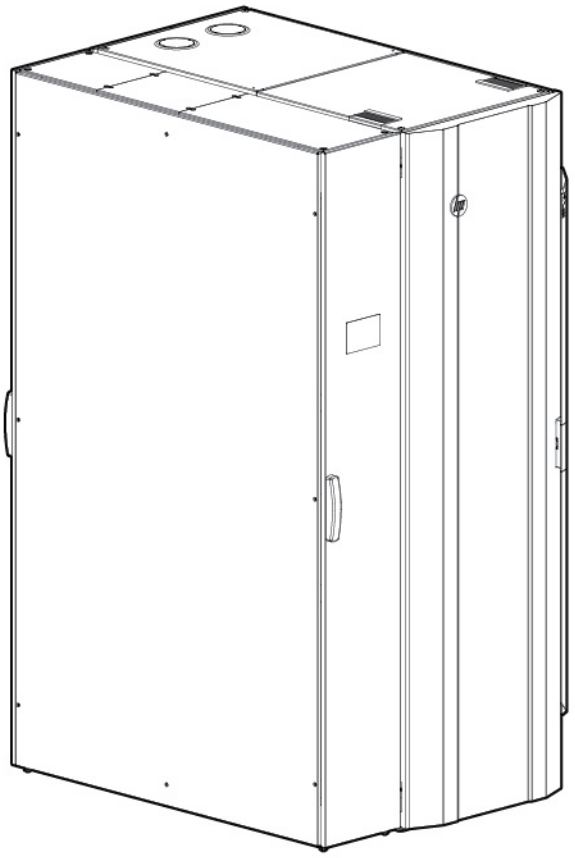
# Overview

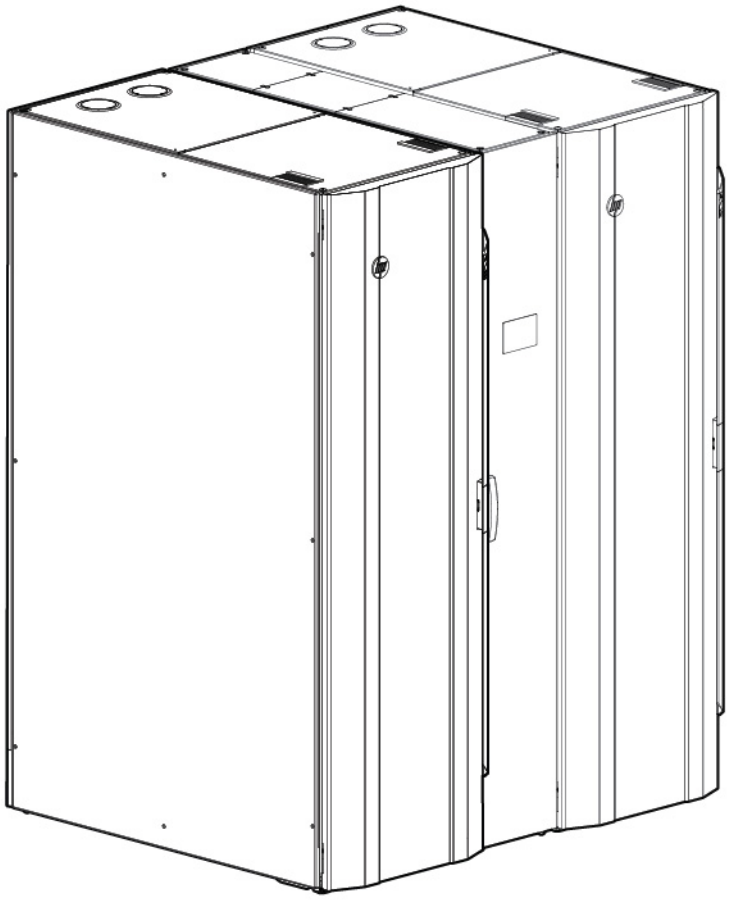
## Overview

The MCS-200/100 is a supplemental cooling system for data centers. It is offered in four configurations:

- MCS-100 unit (single-rack configuration)

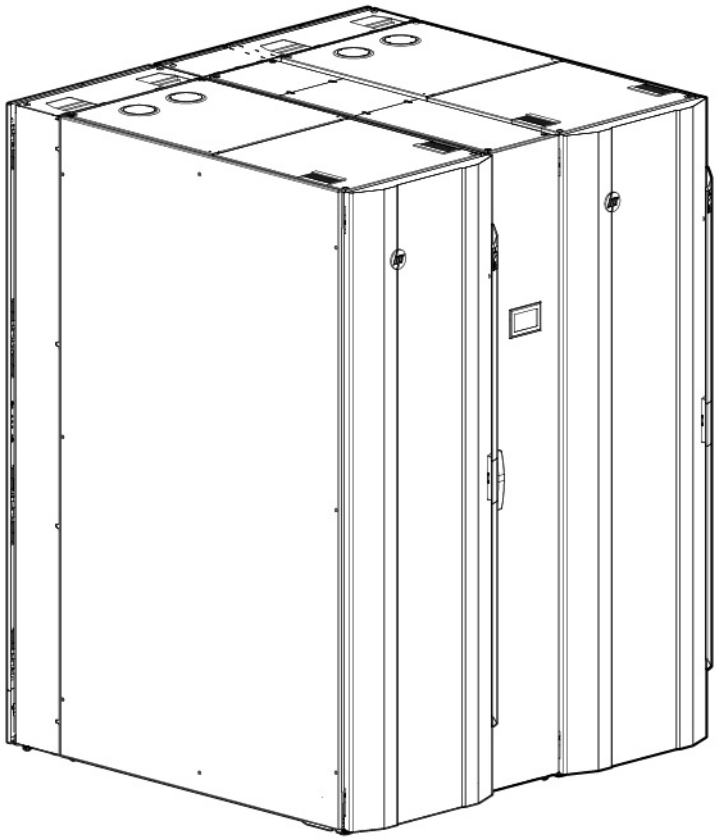


- MCS-100 unit (dual-rack configuration)



- MCS-200 unit (single-rack configuration)

- MCS-200 unit (dual-rack configuration)



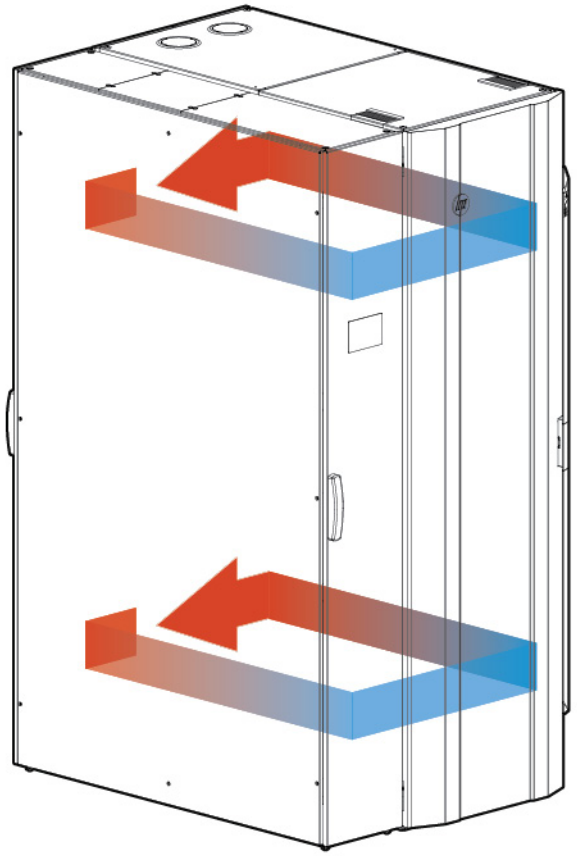
For successful site preparation, consider the following information:

- To provide dedicated cooling for servers and other IT equipment, the MCS-200/100 integrates with the facility chilled water plant or a dedicated chilled water loop. HP recommends that you install a dedicated cooling loop to the MCS-200/100.
- The system provides cooling, recirculation, and condensation management, and it requires a small amount of AC electric power.
- Internal monitoring and control sensors assure server inlet air set points to be achieved and provide constant performance feedback through local and network interfaces.

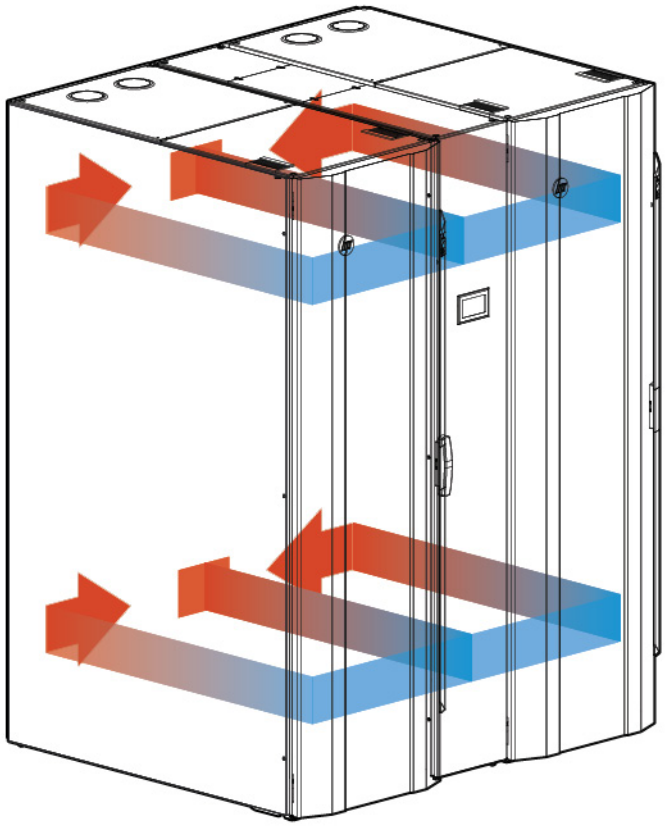
# Product overview

The MCS-200/100 is a modular, distributed cooling solution that removes the high levels of heat generated by current advanced server and mass storage systems. The MCS-200/100 provides a uniform, effective, affordable, and distributed cooling approach for servers and other IT equipment installed in server racks. The MCS-200/100 is a closed-loop cooling system integrated as part of a non-ventilated server enclosure, in contrast to a conventional "open" server enclosure with perforated front and rear doors.

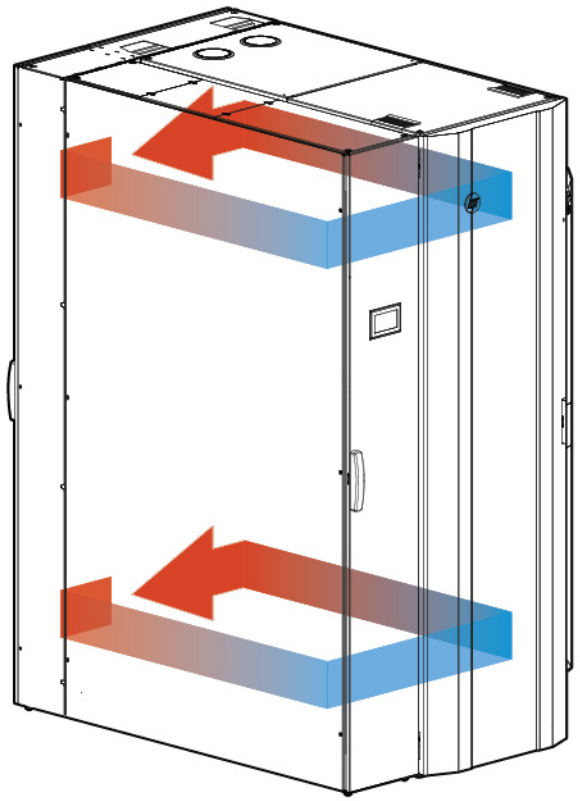
Air flow for MCS-100 (single-rack configuration)



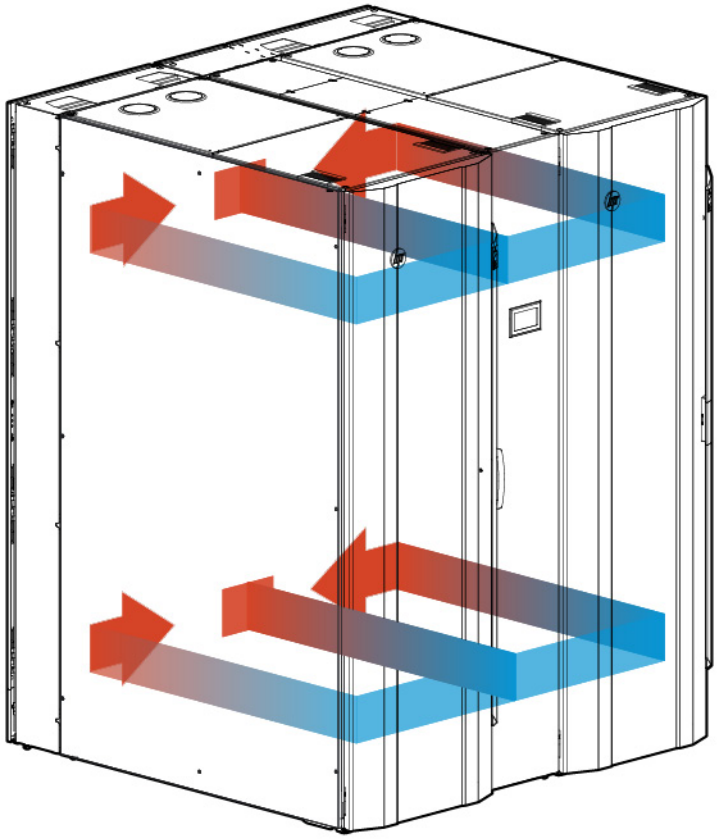
Air flow for MCS-100 (dual-rack configuration)



Air flow for MCS-200 (single-rack configuration)



Air flow for MCS-200 (dual-rack configuration)



The special horizontal airflow of the MCS-200/100 fully supports the industry standard front-to-back cooling principle, such as cold air drawing into the front of the server and warm air being expelled out the rear of the unit. All devices receive adequate and evenly distributed cool air regardless of the mounting position within the enclosure. The MCS-200/100 distributes precisely cooled and targeted air flow evenly across the front of the IT equipment. Warmed air is then channeled from the rear of the IT equipment into the side-mounted or center-mounted MCS-200/100 cooling unit. From there it is cooled and recirculated to the front of the equipment stack.

# Key components

The MCS-200/100 uses the following key components to provide cooling performance. Some of these components are optional for MCS-100. For more information, see "MCS-100 components (on page 13)."

- Main breakers—Provide power for the MCS-200/100 through circuit breakers. They do not control power at the input panel.

  If the MCS-200/100 is still connected to a power source, voltage is applied before the circuit breakers at the input panel
- Heat Exchanger Module (HEX)—Uses an air-to-water heat transfer device specially created for demanding data center environments
- Display—Provides general cooling unit status
- Management module—Provides users with web-based capabilities to set, monitor, and control temperature within the modular cooling unit, and displays the health of the unit

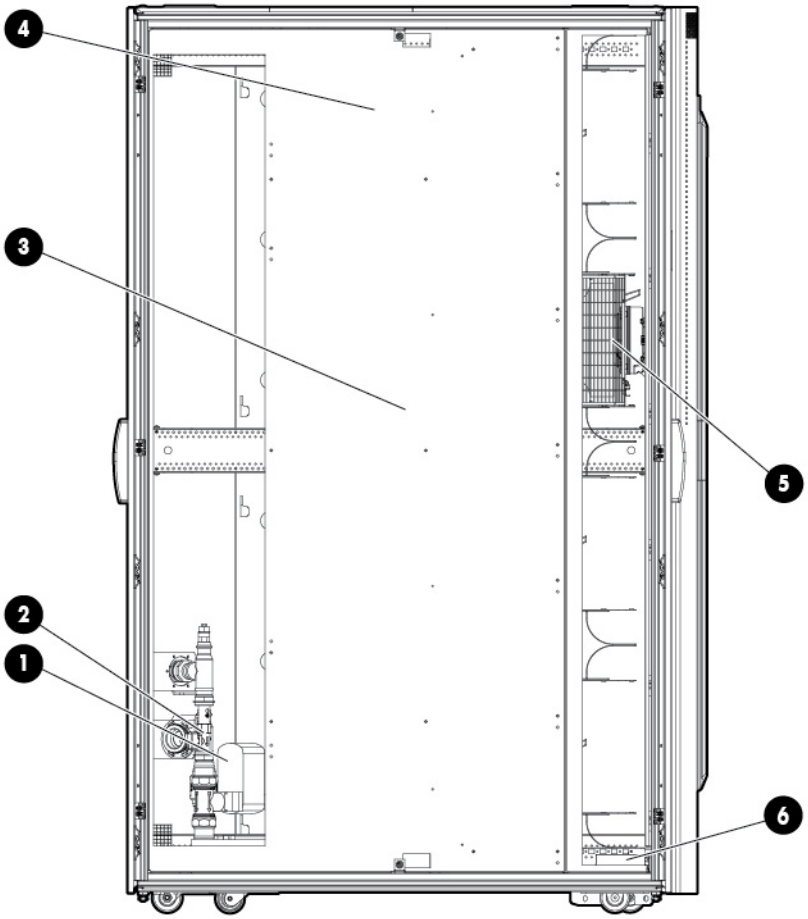
- Fan controller—Operates the fans, according to the cabinet air temperature
- Air bleeder valve—Enables air to manually bleed out of the system when coolant is initially filled
- Water controller—Senses condensation, leaks, water temperatures, flow rate, and the status of the water valve, and sends this data to the management module
- AC input/network connection—Provides primary and secondary AC input connections, if available, and a network management interface
- AC transfer switch—Provides dual-AC power with a fail-over feature for redundancy
- Fans—Provide circulation of cooled air through the computer equipment rack
- Water group—Includes the water valve, flow meter, check valve, and temperature sensors

  A condensation pump with overflow and condensation lines connects to the water group.

  Each MCS-200/100 has one water group.

# MCS-100 components

The MCS-100 is an air and water heat exchanger that removes high levels of excess heat generated by equipment installed in HP racks. The installed equipment pulls cold air in through the front of the closed MCS-100 and uses that air for internal cooling. After the air is warmed, the MCS-100 expels the air through the rear vents.

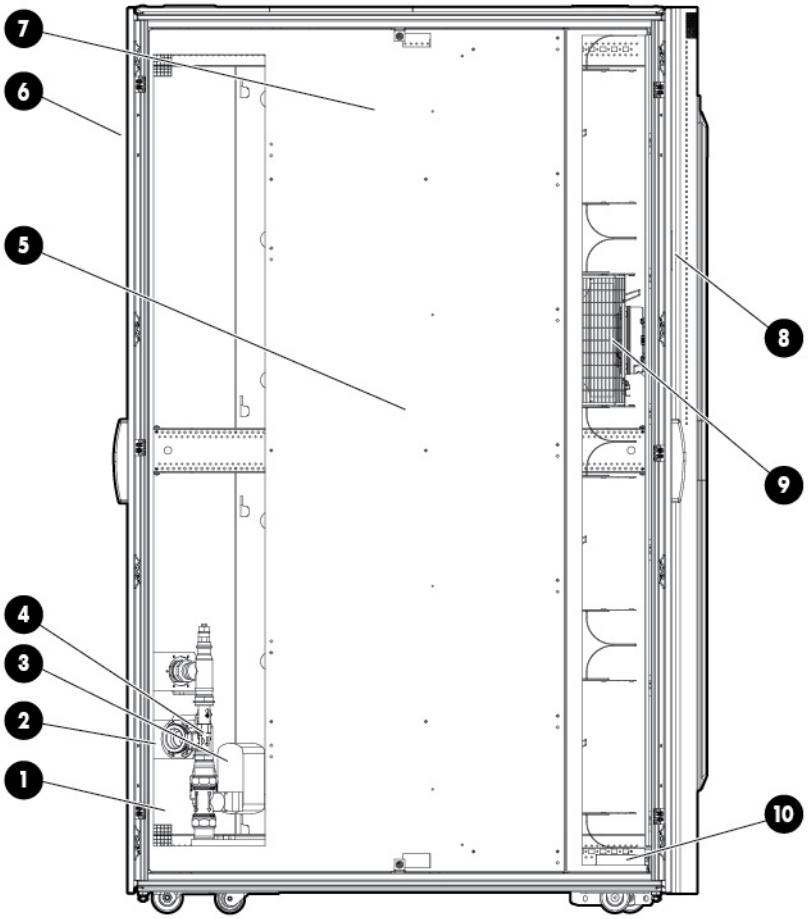


| Item | Description |
|---|---|
| 1 | Control valve |
| 2 | Flow meter |
| 3 | Humidity sensor |
| 4 | Heat exchanger unit |
| 5 | Fan units (1 fan by default, 4 fans maximum) |
| 6 | Management module |

HP provides several components to complement or complete your MCS-100. For more information, see the *HP Modular Cooling System 200/100 Options Installation Guide.*

The following illustrations show the MCS-100 optional components.

**Unit side view**

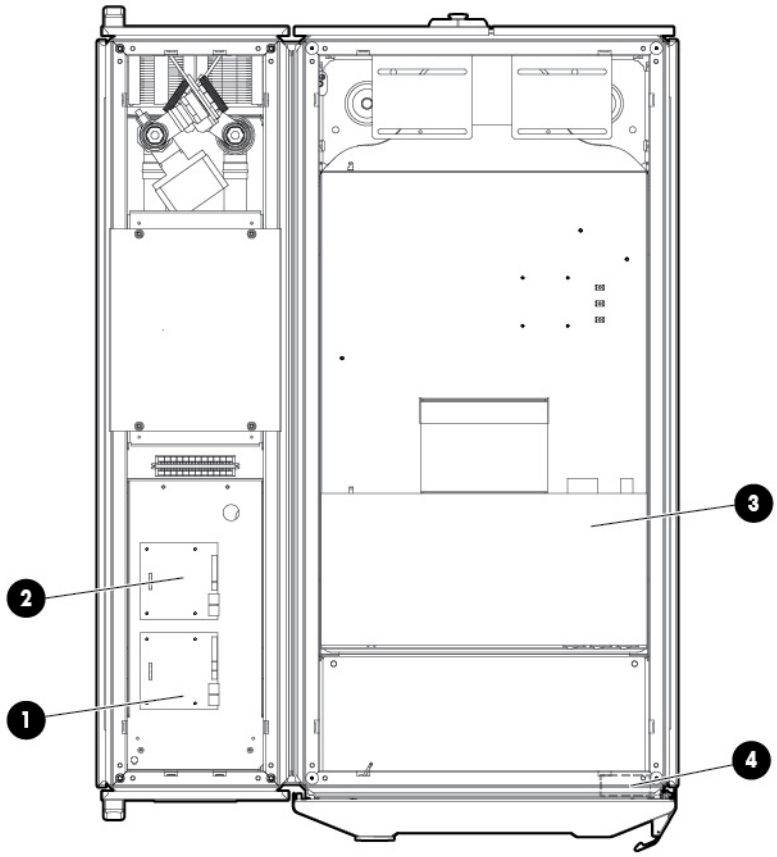



| Item | Reference |
|---|---|
| 1 | Condensation pump (optional) |
| 2 | Condensation pump controller (optional) |
| 3 | Control valve |
| 4 | Flow meter |
| 5 | Humidity sensor |
| 6 | Rear extension (optional) |

| Item | Reference |
|---|---|
| 7 | Heat exchanger unit |
| 8 | TFT touchscreen display (optional) |
| 9 | Fan units (1 fan by default, 4 fans maximum) |
| 10 | Management module |

**Unit top view**

For easier viewing, the canopies are not shown in this illustration.




| Item | Reference |
|---|---|
| 1 | Water module |
| 2 | Fan module |
| 3 | AC power distribution unit (AC transfer switch optional) |
| 4 | Emergency door opening (optional) |

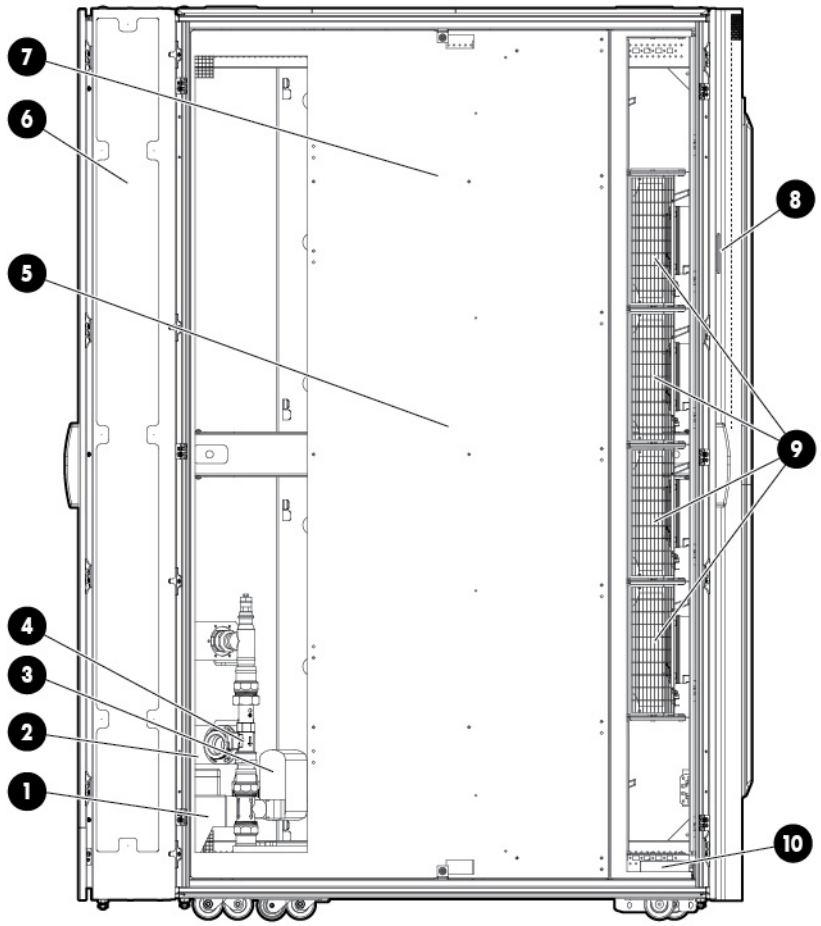
# MCS-200 components

The MCS-200 is an air and water heat exchanger that removes high levels of excess heat generated by equipment installed in HP racks. The installed equipment pulls cold air in through the front of the closed MCS-200 and uses the air for internal cooling. After the air is warmed, the MCS-200 expels the air through the rear vents.

HP provides several components to complement or complete your MCS-200. For more information, see the *HP Modular Cooling System 200/100 Options Installation Guide*.

The following illustrations show the MCS-200 optional components.

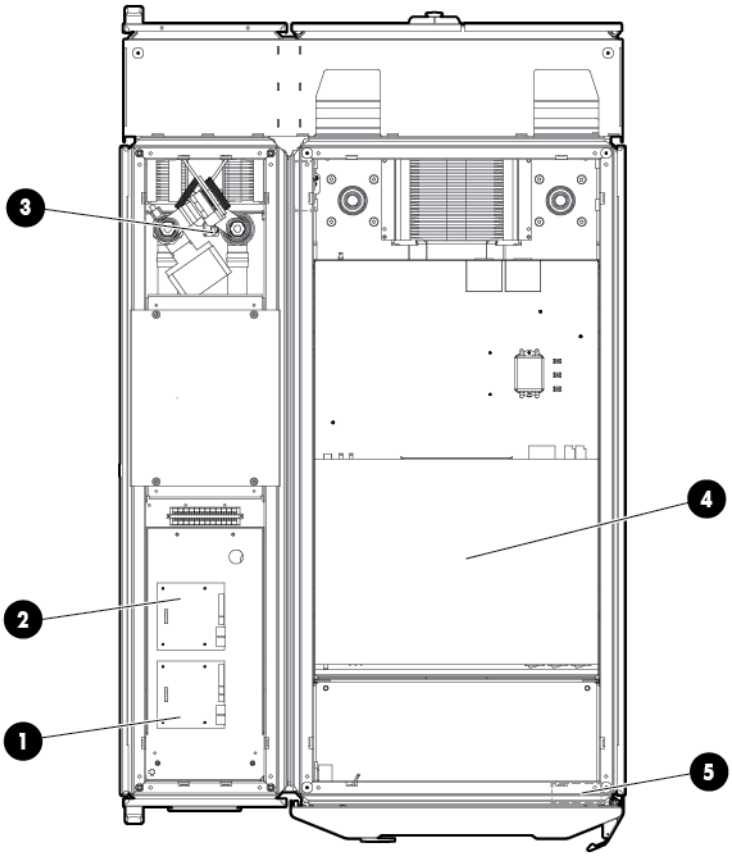
**Unit side view**




| Item | Reference |
|---|---|
| 1 | Condensation pump |
| 2 | Condensation pump controller |
| 3 | Control valve |
| 4 | Flow meter |
| 5 | Humidity sensor |
| 6 | Rear extension |
| 7 | Heat exchanger unit |
| 8 | TFT touchscreen display |
| 9 | Fan units (4 fans by default, 6 fans maximum) |
| 10 | Management module |

**Unit top view**

For easier viewing, the canopies are not shown in this illustration.




| Item | Reference |
|---|---|
| 1 | Water module |
| 2 | Fan module |
| 3 | Condensation pump transformer 277v (optional) |
| 4 | AC transfer switch |
| 5 | Emergency door opening |

# Physical specifications

The following table lists the approximate physical specifications of a single MCS-100 or MCS-200 as received from the factory.

**MCS-100 (single rack configuration) physical specifications**

| Parameter | Packaged system (as shipped on pallet) | Unpackaged system (off pallet, unwrapped) | Unpackaged CTO system |
|---|---|---|---|
| Height | 2285 mm (90 inches) | 2007 mm (79 inches) | 2007 mm (79 inches) |
| Width | 1219 mm (48 inches) | 904 mm (35.6 inches) | 904 mm (35.6 inches) |
| Depth | 1829 mm (72 inches) | 1311 mm (51.6 inches) | 1311 mm (51.6 inches) |
| Weight | 670 kg (1479 lb)[1] | 417 kg (919 lb)[2] | 1324 kg (2919 lb)[3] |

**MCS-100 expansion rack physical specifications**

| Parameter | Packaged system (as shipped on pallet) | Unpackaged system (off pallet, unwrapped) | Unpackaged CTO system |
|---|---|---|---|
| Height | 2159 mm (85 inches) | 2007 mm (79 inches) | 2007 mm (79 inches) |
| Width | 914.4 mm (36 inches) | 600 mm (23.6 inches) | 600 mm (23.6 inches) |
| Depth | 1727 mm (68 inches) | 1200 mm (47.2 inches) | 1200 mm (47.2 inches) |
| Weight | 265 kg (584 lb)[1] | 135 kg (299 lb)[2] | 1042 kg (2297 lb)[3] |

**MCS-200 (single rack configuration) physical specifications**

| Parameter | Packaged system (as shipped on pallet) | Unpackaged system (off pallet, unwrapped) | Unpackaged CTO system |
|---|---|---|---|
| Height | 2285 mm (90 inches) | 2007 mm (79 inches) | 2007 mm (79 inches) |
| Width | 1219 mm (48 inches) | 904 mm (35.6 inches) | 904 mm (35.6 inches) |
| Depth | 1829 mm (72 inches) | 1510 mm (59.5 inches) | 1510 mm (59.5 inches) |
| Weight | 732 kg (1614 lb)[1] | 478 kg (1054 lb)[2] | 1521 kg (3353 lb)[3] |

**MCS-200 expansion rack physical specifications**

| Parameter | Packaged system (as shipped on pallet) | Unpackaged system (off pallet, unwrapped) | Unpackaged CTO system |
|---|---|---|---|
| Height | 2159 mm (85 inches) | 2007 mm (79 inches) | 2007 mm (79 inches) |
| Width | 914.4 mm (36 inches) | 600 mm (23.6 inches) | 600 mm (23.6 inches) |
| Depth | 1727 mm (68 inches) | 1399 mm (55.1 inches) | 1399 mm (55.1 inches) |
| Weight | 308 kg (680 lb)[1] | 179 kg (395 lb)[2] | 1222 kg (2694 lb)[3] |

1 Weight for a completely packaged system with unpopulated server rack
2 Weight for an unpackaged system with unpopulated server rack
3 Approximate weight for an unpackaged CTO system (actual weight varies, according to configuration)

If the top shipping bracket interferes with deploying the MCS-200/100, it can be removed. With the top shipping bracket, the total height of the unpackaged system is 2069 mm (81.5 inches).

# Electrical specifications

The following table lists the electrical specifications for the MCS-100 unit.

| Parameter | Value | Comments |
|---|---|---|
| Operating voltage | 230 VAC +/- 10%, 50 Hz<br>208 VAC +/- 10%, 60 Hz | — |
| AC line phase | Single | — |
| Maximum input current | 18 A | Per line cord |
| Maximum inrush current | 200 A | Per line cord |
| Dropout/hold-up time at minimum line voltage | 20 ms | — |
| Transfer time of AC transfer switch | 2 s | — |
| Circuit breaker rating | LAHJ | Per cord |
| Power factor | > 0.95 | At all loads |
| Ground leakage current | < 19.4 mA | Per line cord |

| Parameter | Value | Comments |
|---|---|---|
| Power cord | 230 V, 16 A<br>208 V, 18 A | IEC 309-to-Procon 700105<br>NEMA L6-20-to-Procon 700105 |

The following table lists the electrical specifications for the MCS-200 unit.

| Parameter | Value | Comments |
|---|---|---|
| Operating voltage | 230 VAC +/- 10%, 50 Hz,<br>277 VAC +/- 10%, 60 Hz,<br>and 208 VAC +/- 10%, 60 Hz | — |
| AC line phase | Single | — |
| Maximum input current | 18 A | Per line cord |
| Maximum inrush current | 200 A | Per line cord |
| Dropout/hold-up time at minimum line voltage | 20 ms | — |
| Transfer time of AC transfer switch | 2 s | — |
| Circuit breaker rating | LAHJ | Per cord |
| Power factor | > 0.95 | At all loads |
| Ground leakage current | < 19.4 mA | Per line cord |
| Power cords | 230 V, 16 A<br>208 V, 18 A | IEC 309-to-Procon 700105 (Qty 2)<br>NEMA L6-20-to-Procon 700105 |

# Facility planning for implementation

## Facility planning overview

The MCS-200/100 offers an incremental data center cooling solution, capable of cooling 30 kW of heat with the MCS-100 unit or 50 kW of heat with the MCS-200 unit.

In planning water supply and design, take into consideration short and long-term needs for cooling. Immediate supply needs must meet the specifications and target cooling requirements, based on the parameters defined in this site preparation guide. In anticipation of future heat loads, design and install dedicated loop chilled water piping, based on specific cooling load increments (such as 50 kW or 250 kW), the specific number of MCS-200/100 per row or loop, and other site build-out planning parameters. As cooling, rack space, and equipment density requirements increase, you can add MCS-200/100 units to the chilled water system.

To route water lines to your MCS-200/100 unit, use one of the following methods:

- Through an opening in the raised floor
- Lying on top of the floor (for MCS-200 only)
- Through the top of the MCS-200/100 unit

For more information on routing the water lines, see the Hook Up Kit installation instructions in the *HP Modular Cooling System 200/100 Options Installation Guide*.

Installation service for the MCS-200/100 is order number UE005E.

For site evaluations and technical consulting for your site, see the HP Services website (http://www.hp.com/services/criticalfacilities).

The implementation of the MCS-200/100 aligns with Data Center Best Practices. For more information, see *Optimizing Data Centers for High-Density Computing*, which can be found on the HP website (http://h18004.www1.hp.com/products/servers/proliantstorage/racks/10000series/documentation.html).

This section discusses key issues for site preparedness, including:

- Space considerations for delivery, operation, and service, and other space-related considerations such as floor loading
- Electrical considerations
- Coolant source options and quality considerations
- Other considerations

A complete site preparation checklist is provided in Appendix A: Forms and checklists (on page 81).

## Space and positioning considerations

When fully populated, the MCS-200/100 unit is larger and heavier than a standard 482.6 mm (19-inch) equipment rack. Therefore, more space is required to maneuver, operate, and service the MCS-200/100.

# Delivery space requirements

Be sure your facility has adequate space to receive and remove the MCS-200/100 from the shipping pallet. Consider the following when unloading the racks:

- Forklifts must enter and transport the shipping pallet from the side.
- Delivery plans must include the possible removal of walls or doors.

MCS-200/100 dimension requirements

| Dimension requirements | MCS-200/100 | MCS expansion rack |
|---|---|---|
| Total length allowed to safely remove the MCS-200/100 from the shipping pallet down the provided ramps | approximately 6.1 m (20 ft) | approximately 6.2 m (20.6 ft) |
| Packaged dimensions of the MCS-200/100 (including shock pallet and cartons) | 2285 mm (90 inches) height x 1219 mm (48 inches) width x 1829 mm (72 inches) depth | 2159 mm (85 inches) height x 914.4 mm (36 inches) width x 1727 mm (68 inches) depth |

# Maneuvering space requirements

⚠ **WARNING:** To reduce the risk of personal injury or damage to the equipment, do not attempt to move equipment racks alone. Obtain adequate assistance to stabilize the rack during movement, or hire professional equipment riggers.

⚠ **WARNING:** To reduce the risk of personal injury or damage to the equipment, use extreme care when moving racks with casters. Sudden stops, excessive force, and uneven surfaces can cause the product to overturn.

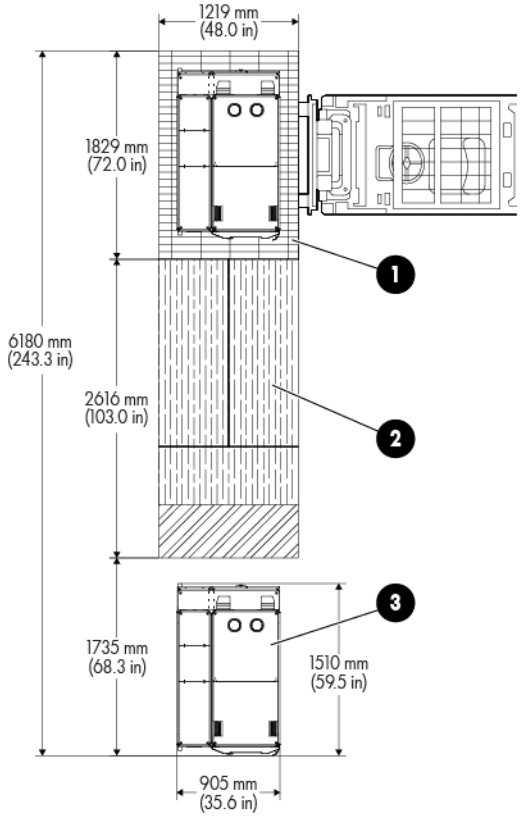
When maneuvering the MCS-200/100, use the following guidelines:

- Move racks that have casters with care. Sudden stops, excessive force, and uneven surfaces might cause the product to overturn.
- Due to stability and safety concerns, the cooling unit and IT rack have casters that are fixed to the front and swivel in the back. For more ease, move the MCS-200/100 with the back as the leading edge.
- For long and straight distances, roll the MCS-200/100 with the front fixed casters leading. For better mobility, lead with the rear swiveling casters.
- When rolling the MCS-200/100, push firmly on the front doors frame and not the door mesh of the IT rack. The points where you should push theMCS-200/100 are marked by the factory.
- Be sure that the rooms and doors are large enough to accommodate the movement of the MCS-200/100 cabinet into the data center.
- When transporting the MCS-200/100 to a different building floor, ensure the elevators have adequate load capacity, floor space, and door clearance to accommodate the rack. The MCS-200/100 pallet can only be moved with forklifts from the side, which has a length of 1829mm (72 inches).
- When transporting the MCS-200/100 within a building, ensure that doorway thresholds are adequate to hold the rack. HP does not recommend that you lift or transport the MCS-200/100 by eyebolts that are attached to the upper corners of the cabinet.

The following figure shows the maneuvering space required when unloading the MCS-100 and MCS-200 from a pallet. When planning to maneuver the unit, use the delivery forms provided in "Appendix A: Forms and checklists (on page 81)."

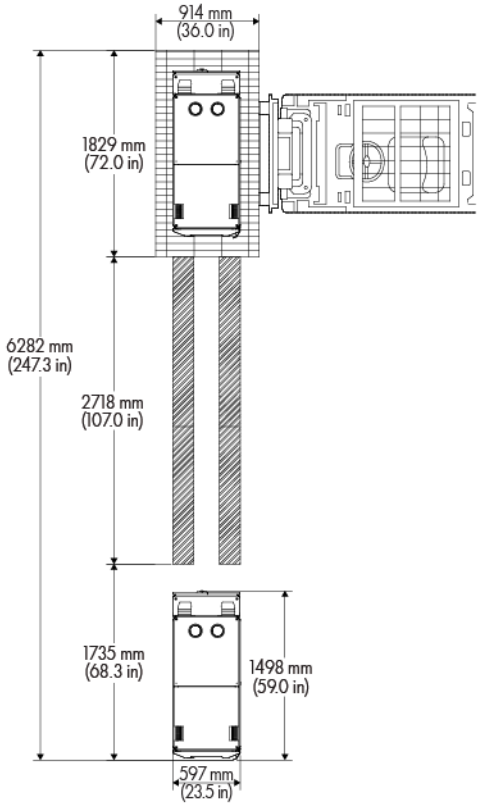
△ **CAUTION:** HP recommends that a ramp angle of no greater than 5° be used to move the MCS-200/100 up or down elevations. Typical data center ramps have a 5° angle (1 to 12 pitches).

MCS-200/100




| Item | Reference |
|---|---|
| 1 | MCS-200/100 shock pallet |
| 2 | 3-piece ramp |
| 3 | MCS-200 rack (MCS-100 rack not shown) |

MCS-200/100 expansion rack




| Item | Reference |
|---|---|
| 1 | MCS-200/100 expansion rack shock pallet |
| 2 | 4-piece ramp |
| 3 | MCS-200 expansion rack (MCS-100 expansion rack not shown) |

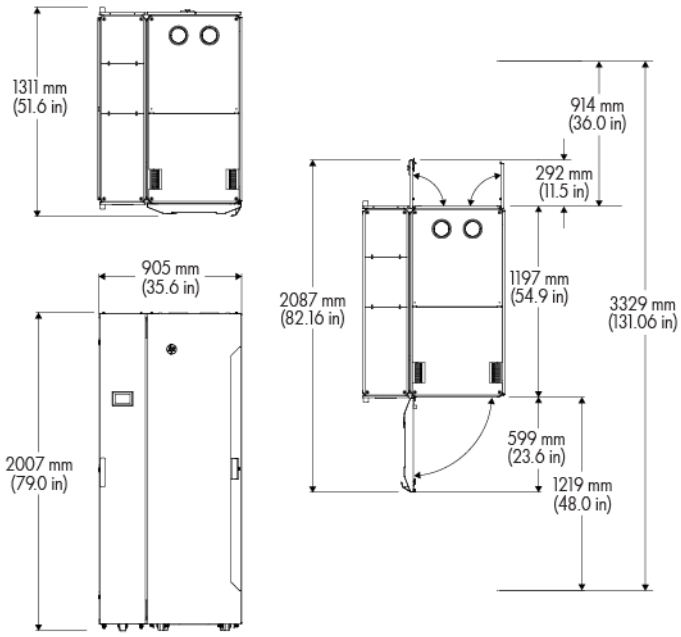
# Operational space requirements

To provide space for internal airflow and housing of the cooling unit components, the MCS-200/100 is wider and deeper than conventional HP racks.

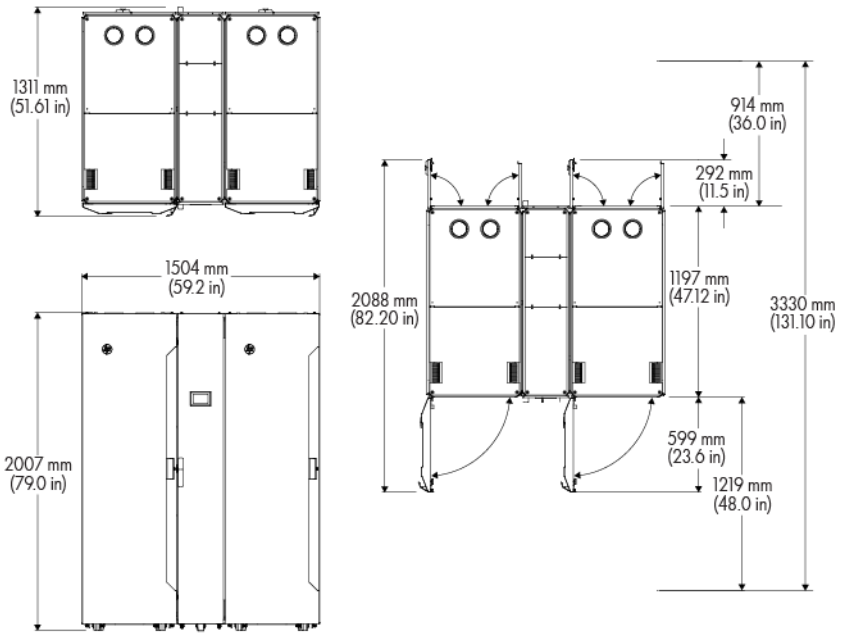
HP recommends the minimum access space for the MCS-200/100 be 1219 mm (4 ft) in the front and 914 mm (3 ft) in the rear, as shown in the following figures.

- With the top shipping bracket, the total height is 2069 mm (81.5 inches).
- The MCS-200/100 unit requires approximately 600 mm of additional width (space) to accommodate the second IT rack, which is mounted to the left of the cooling unit.

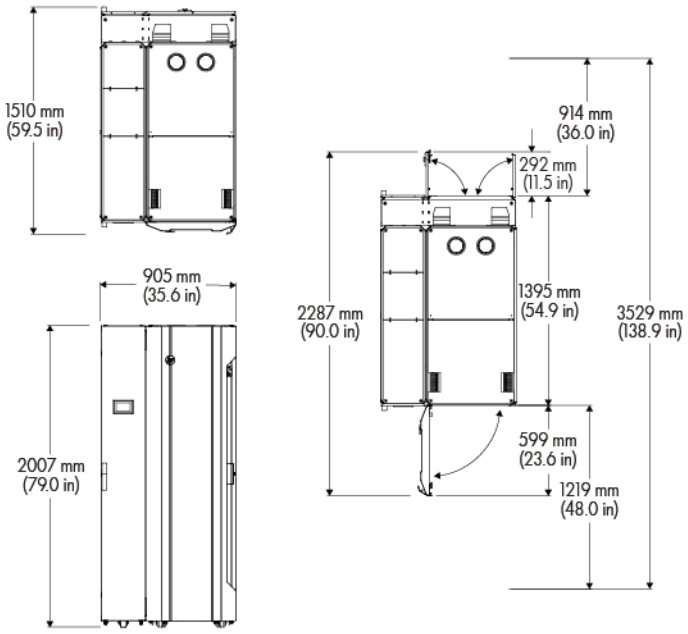
MCS-100 unit (single-rack configuration)



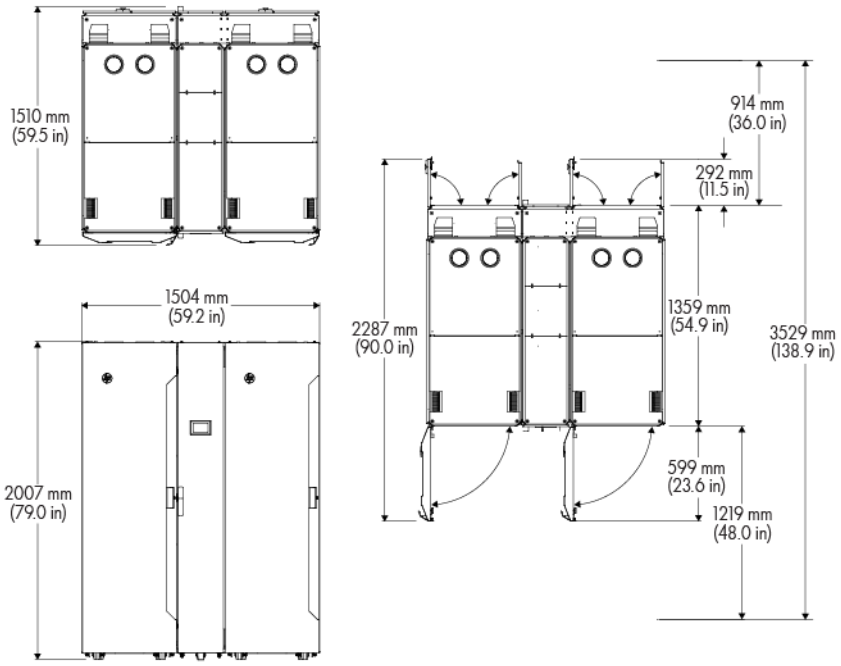

MCS-100 unit (dual-rack configuration)



MCS-200 unit (single-rack configuration)



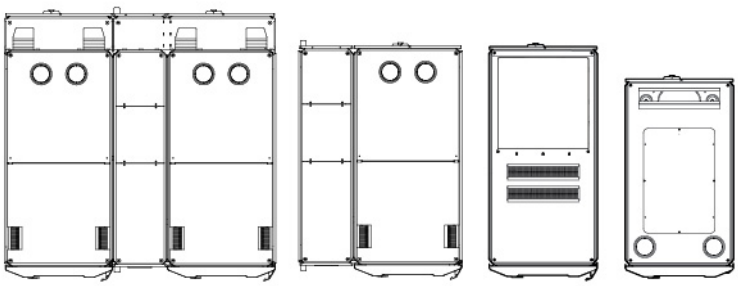

MCS-200 unit (dual-rack configuration)




# System positioning

The MCS-200/100 can be installed next to an existing or new row of HP Intelligent Series racks. Based on facility design requirements, the cabinets can be arranged in a flush front or flush rear configuration.

Flush front configuration examples



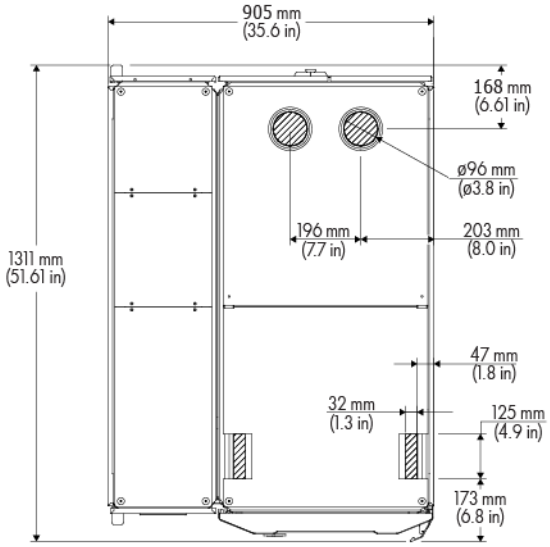
When arranging the MCS-100 or MCS-200/100 next to an HP Intelligent Series rack, and depending on the configuration, be aware of the potential for slight rear door swing interference. Equipment might require the removal of a door during installation to allow for unimpeded access.

# Cable openings

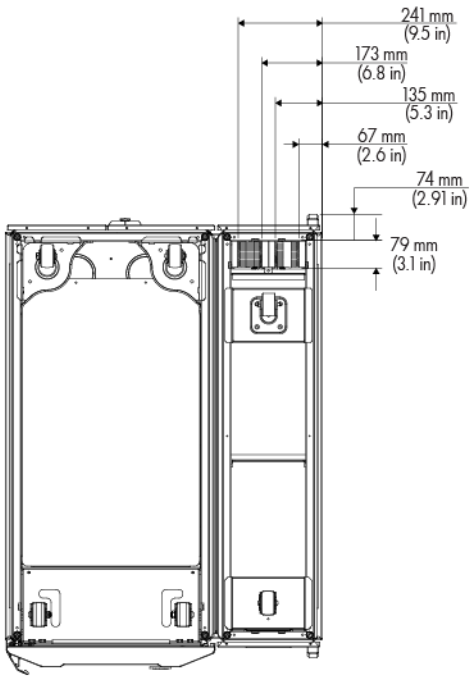
The MCS-100 and MCS-200 units have several useable cable openings at front top, rear bottom and rear top of the IT rack.

The following figure shows the size and position of the cable openings at the top and bottom in the MCS-100 (single-rack configuration).

- Top view

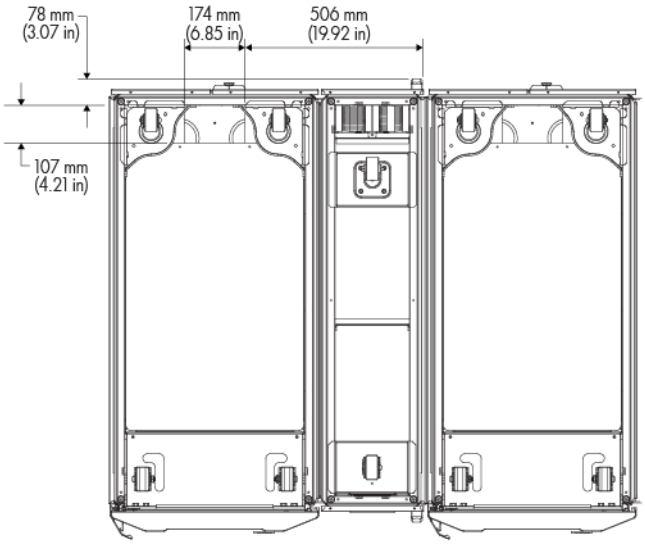


- Bottom view




The following figure shows the size and position of the cable openings at the top and bottom in the MCS-100 (dual-rack configuration).

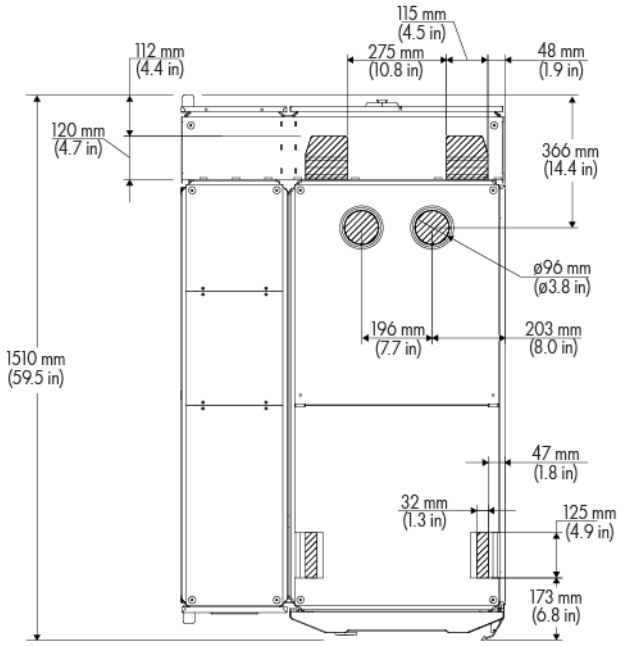
- Top view



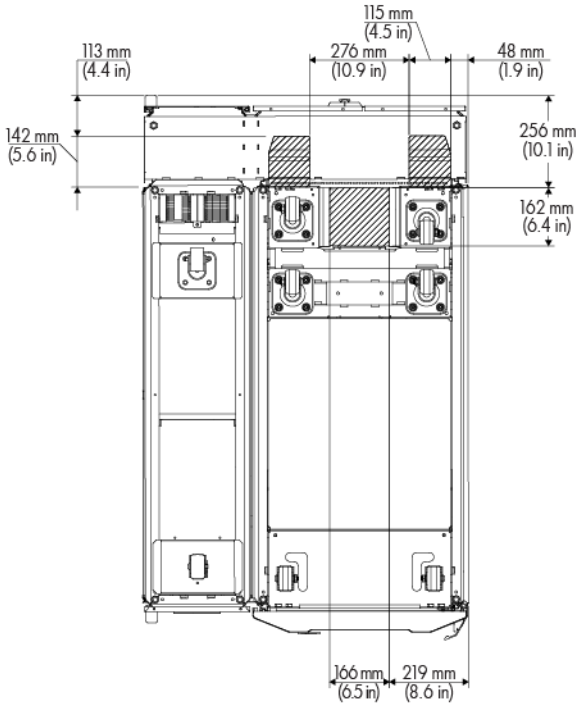

- Bottom view

The following figure shows the size and position of the cable openings at the top and bottom in the MCS-200 (single-rack configuration).

- Top view

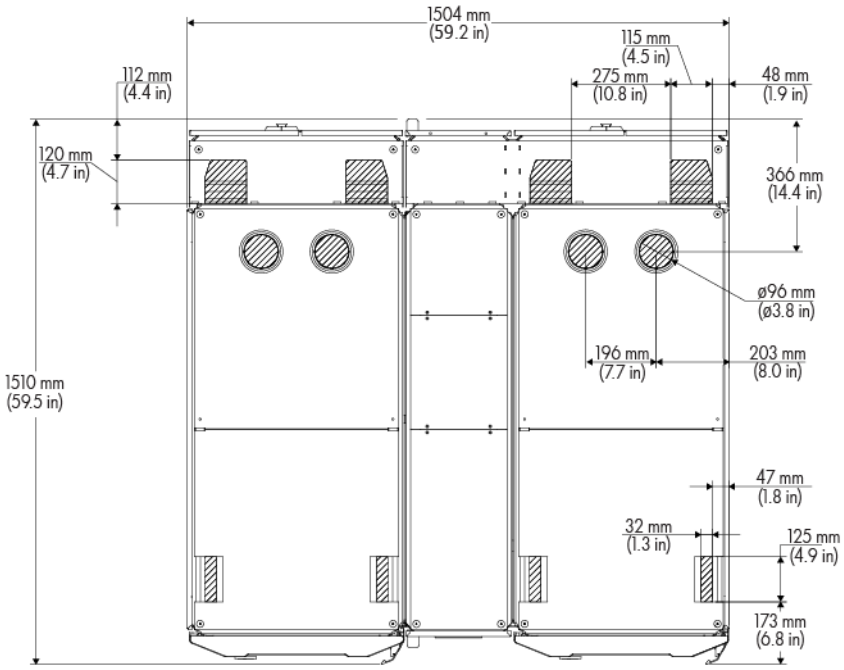



- Bottom view

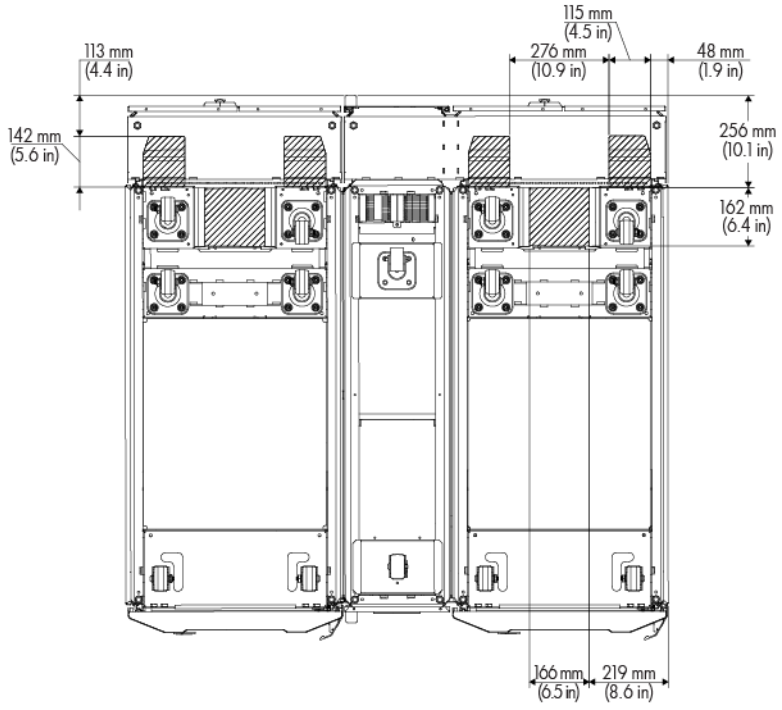



The following figure shows the size and position of the cable openings at the top and bottom in the MCS-200 (dual-rack configuration).

- Top view




- Bottom view




# Cabinet leveling feet

⚠ **WARNING:** Static loading limits cannot be achieved if the rack is not on its leveling feet or is rolled or pushed from its position. Your floor weight capacity might not support the full static load capacity. Check with your floor provider before loading. HP is not responsible for floor damages due to floor overloading.

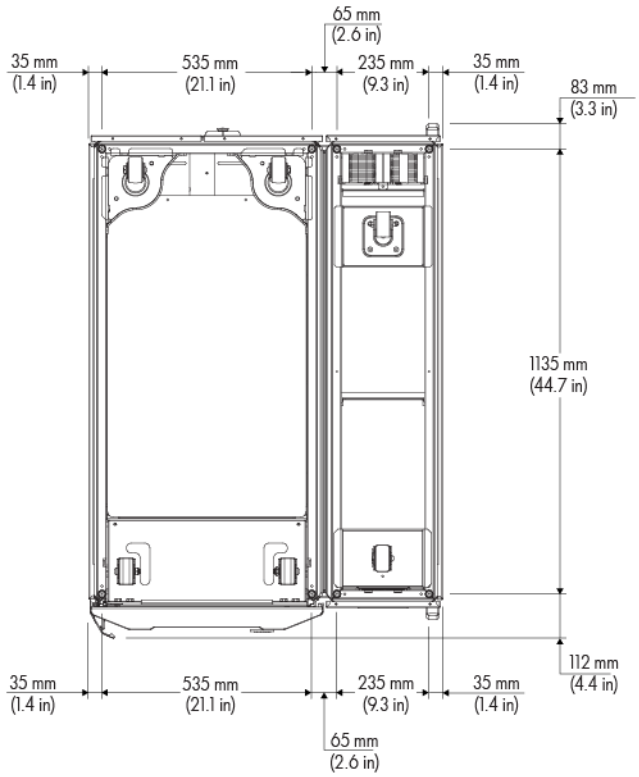
⚠ **CAUTION:** To reduce the risk of damage to the casters, make sure that the full weight of the rack rests on the leveling feet and feet pads, and not on the casters. The casters are designed only as an aid in moving the rack into position. They are not designed to support the weight of the rack, and the casters may become damaged if relied on to support the rack.

The MCS-200/100 includes leveling feet and does not require fastening to the floor. Care should be taken during the loading of the equipment to ensure the rack remains stable during operation and servicing to avoid personnel and equipment damage. MCS-200/100 both support approximately up to 1361 kg (3000 lb) of static equipment load on the leveling feet and feet pads.

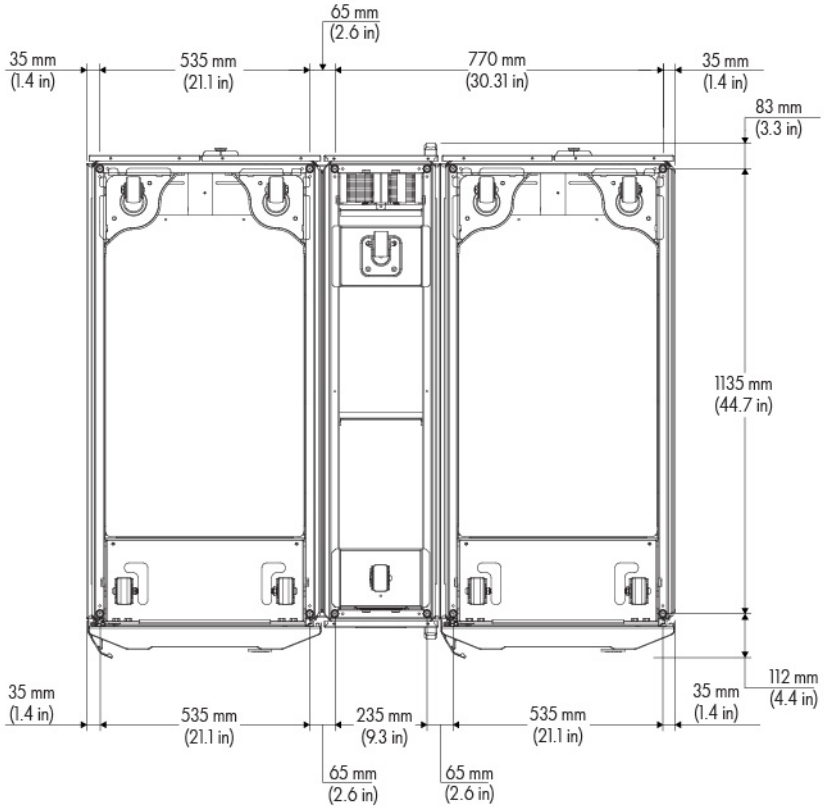
The following figures show the locations of the cabinet leveling feet. Be sure there is adequate floor and remaining understructure support to handle the load-bearing leveling feet, especially immediately around the cutout. After the MCS-200/100 is positioned in the proper location in the data center, it can be lowered into place with the leveling feet and leveling feet pads.

**MCS-100 cabinet leveling feet locations:**

- Bottom view
  - MCS-100 single-rack configuration

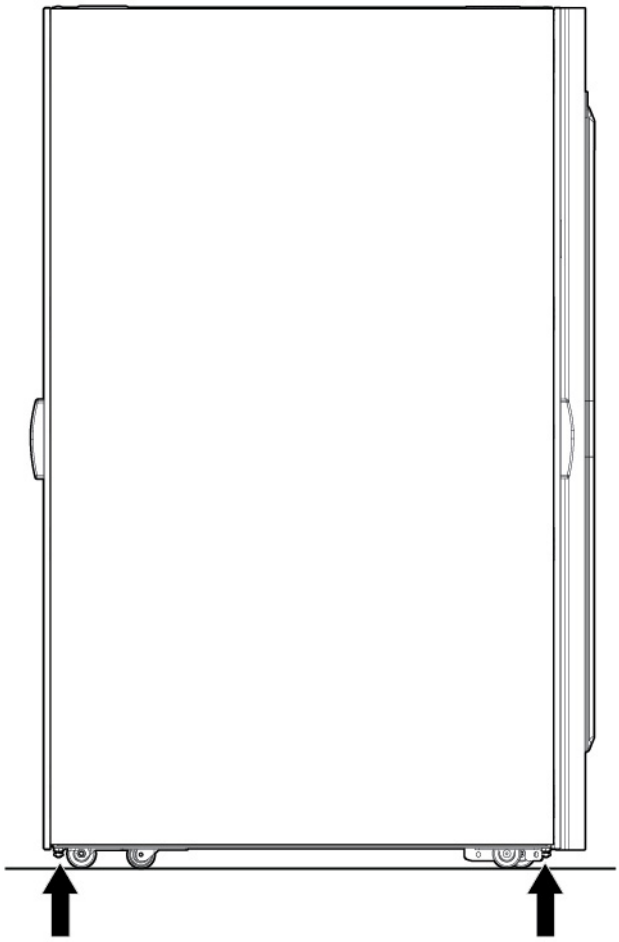


- MCS-100 dual-rack configuration

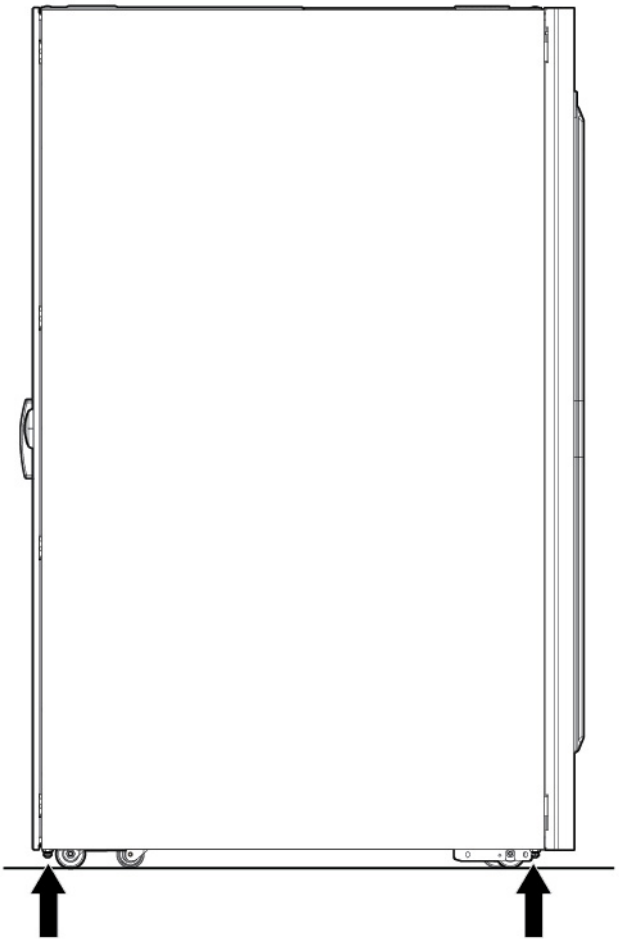



- IT rack side view

- MCS-100 single-rack configuration



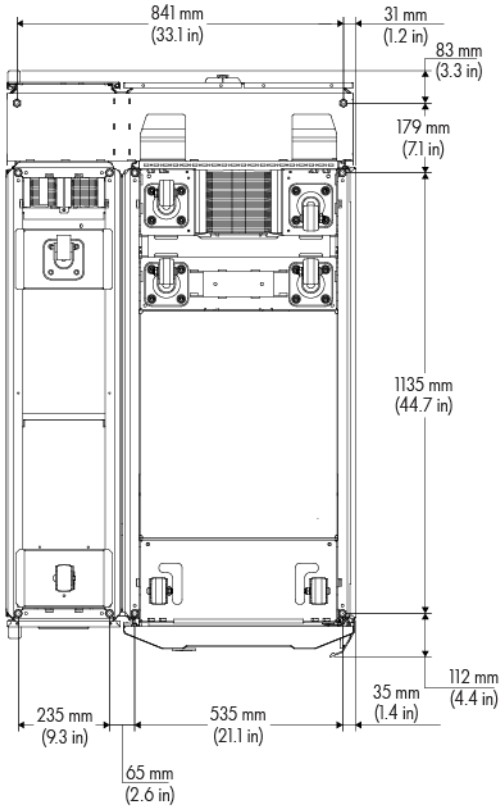
- MCS-100 dual-rack configuration



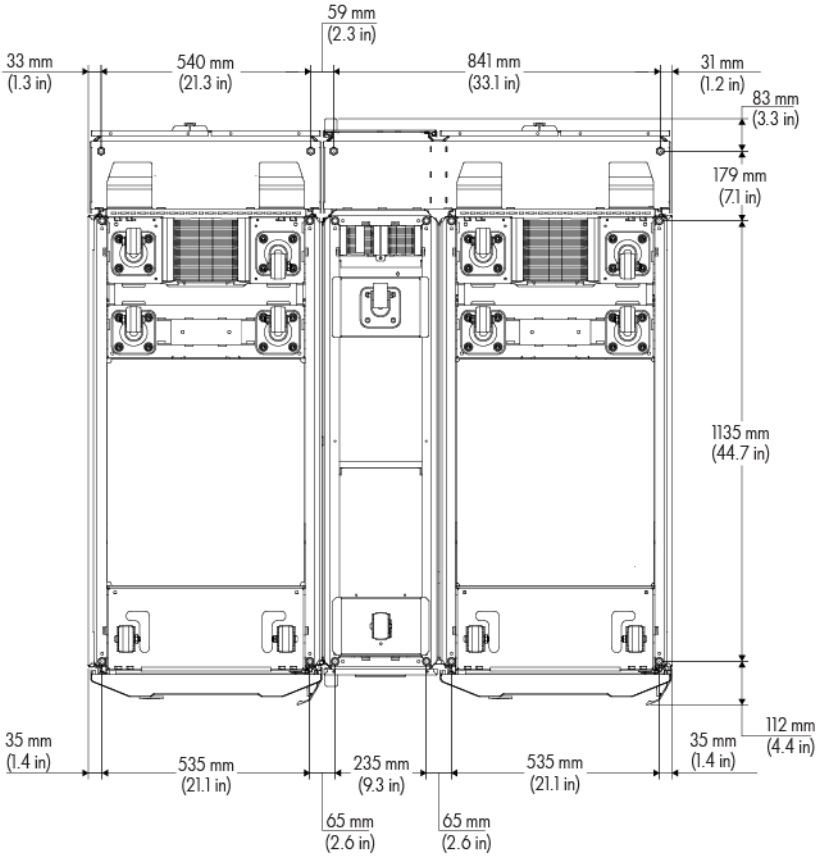
**MCS-200 cabinet leveling feet locations:**

- Bottom view

- MCS-200 single-rack configuration

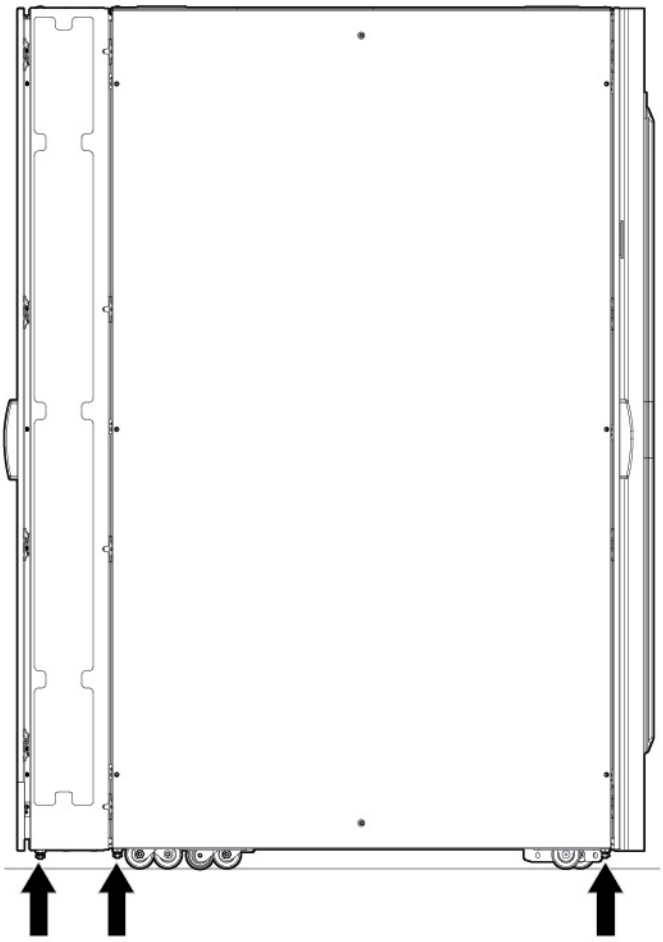


- MCS-200 dual-rack configuration

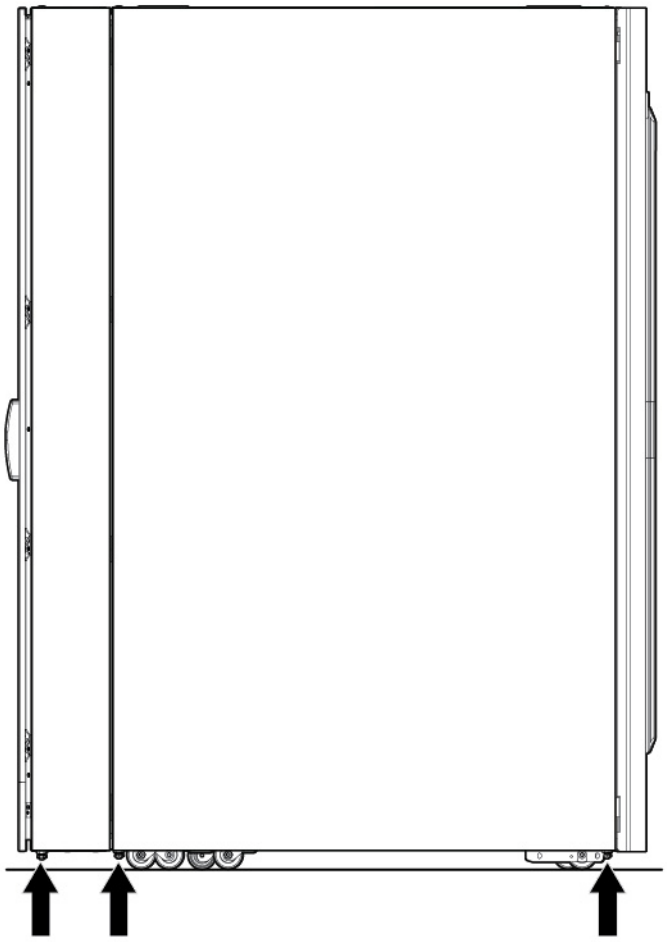



- IT rack side view

- MCS-200 single-rack configuration



- MCS-200 dual-rack configuration



The leveling feet pads help to ensure weight distribution and help transfer the load to the support structure below the floor. You must ensure proper orientation of the feet pads so that subsequent racks can be properly accommodated.

# Floor loading considerations

The computer room floor must be able to support the total weight of the installed server trays as well as the weight of the MCS-200/100 as they are moved into position. This section contains information about raised floor installations. HP cannot assume responsibility for determining the suitability of a particular raised floor system. The customer or local agencies should determine installation requirements. An appropriate structural engineer should verify any floor system under consideration for a server installation.

Raised floor loading is a function of the manufacturer's load specification and the positioning of the equipment relative to the raised floor grid. HP recommends the following guidelines:

- Some raised floor systems do not have grid stringers between floor stands. The lateral support for the floor stands depends on adjacent panels being in place. To avoid compromising this type of floor system when gaining under-floor access, remove only one floor panel at a time.
- Larger floor grids (bigger panels) are generally rated for lighter loads.
- MCS-200/100 both support approximately up to 1361 kg (3000 lb) of static loads of equipment on the leveling feet and feet pads.

The MCS-200/100 has not been certified for seismic environments.

The following table can be used to calculate the weight load of each MCS-200/100 unit, including installed equipment for proper floor planning.

**MCS-100 weight calculation**

| Component | Unit weight | Quantity (multiple by) | Total weight |
|---|---|---|---|
| MCS-100 (with no server trays) | 670 kg (1479 lb) | 1 | 670 kg (1479 lb) |
| Component #1: HP ProLiant SE2x8530a Gen8 Server Tray* | 11.21 kg (24.72 lb) | 80 | 897 kg (1978 lb) |
| Component #2: | | | |
| Component #3: | | | |
| Component #4: | | | |
| Rack Total: | | | |

*Component #1 text included as an example

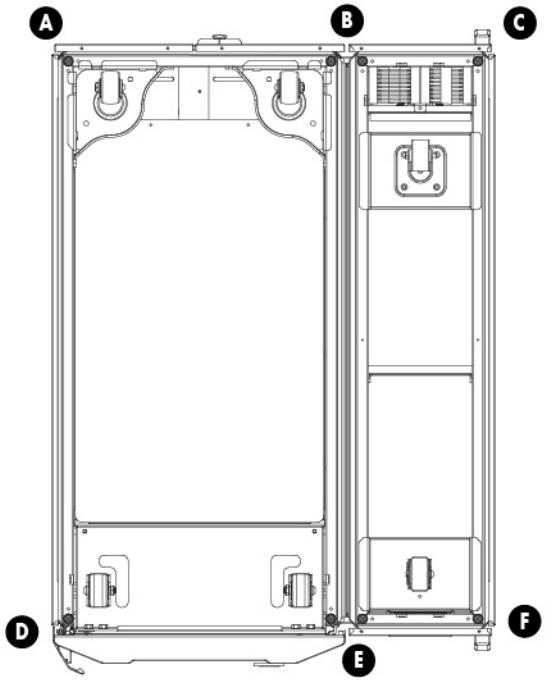
**MCS-200 weight calculation**

| Component | Unit weight | Quantity (multiple by) | Total weight |
|---|---|---|---|
| MCS-200 (with no hose kits or IT equipment installed) | 732 kg (1614 lb) | 1 | 732 kg (1614 lb) |
| Component #1: Mellanox Infiniband switch* | 21.22 kg (46.8 lb) | 1 | 21.22 kg (46.8 lb) |
| Component #2: | | | |
| Component #3: | | | |
| Component #4: | | | |
| Rack Total: | | | |

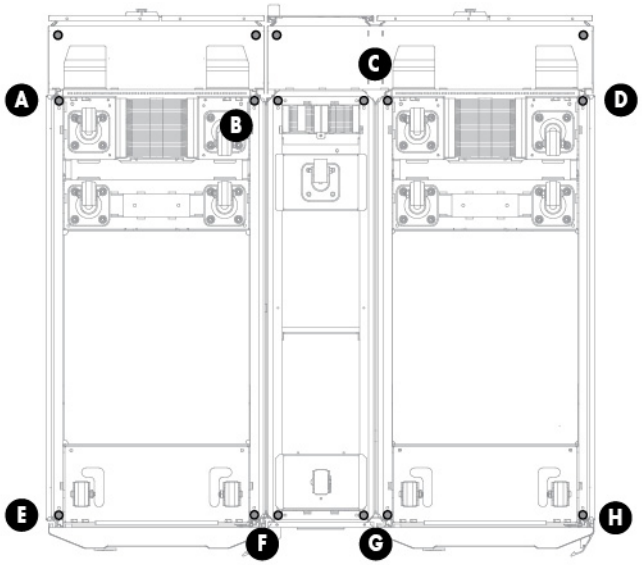
*Component #1 text included as an example

In the following figure, the load is in the center of the IT racks. Due to adjacency, the leveling feet are combined to one concentrated weight.

The weight distribution on the leveling feet locations in MCS-100 and MCS-200 are very similar.




| Item | Weight |
|---|---|
| A | 79 kg (174 lb) |
| B | 458 kg (1010 lb) |
| C | 385 kg (349 lb) |
| D | 83 kg (183 lb) |
| E | 457 kg (1008 lb) |
| F | 375 kg (827 lb) |



| Item | Weight |
|---|---|
| A | 385 kg (849 lb) |
| B | 455 kg (1003 lb) |
| C | 458 kg (1010 lb) |
| D | 385 kg (849 lb) |
| E | 375 kg (827 lb) |
| F | 457 kg (1007 lb) |
| G | 457 kg (1007 lb) |
| H | 375 kg (827 lb) |

**CAUTION:** To reduce the risk of damage to the casters, make sure that the full weight of the rack rests on the leveling feet and feet pads, and not on the casters. The casters are designed only as an aid in moving the rack into position. They are not designed to support the weight of the rack, and the casters may become damaged if relied on to support the rack.

## Common floor-loading terms

| Term | Description |
|---|---|
| Dead load | The weight rating for the load the floor can support expressed in kg/m² (lb/ft²) |
| Uniform load | The load that the floor system can safely support; expressed in kg/m² (lb/ft² or kN/m²) |
| Concentrated load* | The load that a floor panel can support on a 25 x 25 mm² (1 x 1 inches²) at the panels weakest point (typically the center of the panel), without the surface of the panel deflecting more than a predetermined amount |
| Rolling load | The load a floor panel can support (without failure) when a wheel of specified diameter and width is rolled across the panel |

## Example: Tate All Steel 1250 raised floor specifications

| Item | Rating |
|---|---|
| Dead load | 34.2 kg/m² (7 lb/ft²) |
| Uniform load | 1,552 kg/m² (400 lb/ft²) |
| Concentrated load* | 567 kg (1,250 lb) |
| Rolling load | 227 kg (500 lb) |

*With 2.54 mm (0.10 inch) of span maximum deflection

# Electrical considerations

The electrical practices and suggestions in this guide are based on North American practices. For regions and areas outside North America, local electrical codes take precedence. An example would be the recommendation that the protective ground conductor should be green with yellow stripes—this requirement is a North American directive and does not override the local code requirements for a region or areas outside North America.

**WARNING:** To avoid personal injury and damage to the equipment, be sure that an emergency power shut off switch is in place and is easily accessible.

The MCS-200 provides two Walther Procon A5 series AC input connections and ships with one set of two power cords for connecting to redundant AC power busses, when available. Only one power cord is necessary for operation. The second cord can be connected to a redundant AC power bus to improve system availability by protecting against power source failures or accidentally tripped circuit breakers.

These redundant connections and cords are optional for the MCS-100.

For more information, see "Connecting to facility A/C power (on page 43)."

# System grounding

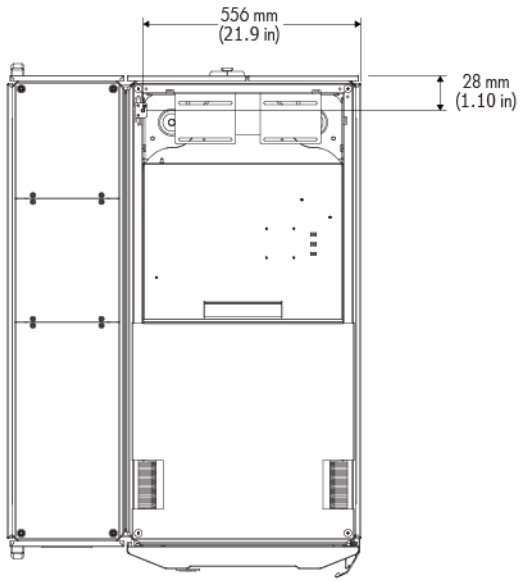
HP server systems require two methods of grounding: power distribution grounding for safety, and high-frequency signal grounding for equipment performance. Power distribution grounding involves the main building electrical service entrance, electrical conduit, facility power panels, and equipment cabinets (including the MCS-200/100 and server cabinets), which should be grounded using green or yellow insulated wire conductors according to the applicable electrical codes. High-frequency grounding consists of using ground return conductors for intra- and inter-cabinet signal interconnects as well as chassis and cabinet grounding.

For MCS-200/100 and server systems installed on a raised floor, the floor assembly should be electrically grounded to form a complete ground grid. An optimum raised-floor grounding solution is shown in the following figure.

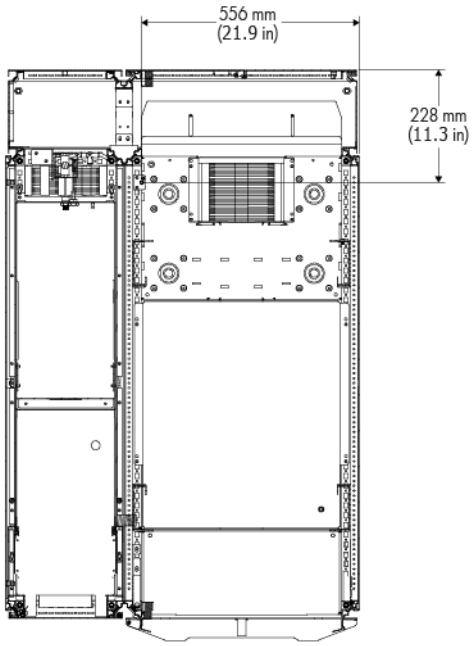
Each floor panel should have at least one supporting pedestal grounded to the power panel and another pedestal grounded to an equipment cabinet. This broadband solution provides excellent grounding for improved safety and performance.

**Central ground stud location inside the IT rack**

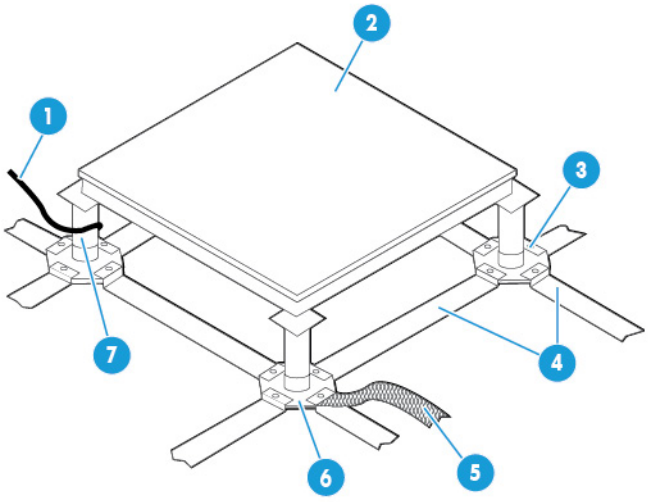
MCS-100



MCS-200




**Raised floor grounding**




| Item | Description |
|---|---|
| 1 | Ground wire to power panel |
| 2 | Floor panel |
| 3 | Hex bolt |
| 4 | Grounding grid element |
| 5 | Grounding braid to computer equipment |
| 6 | Band and pedestal |
| 7 | Grounding clamp |

# Voltage fluctuations and outages

The MCS-200/100 is designed to provide immunity to power outages of less than one cycle. However, testing cannot conclusively rule out loss of service. To obtain the best possible performance of power distribution systems for HP equipment, observe the following guidelines:

- Dedicated power source—Isolates the power distribution system from other circuits in the facility
- Missing-phase and low-voltage detectors—Automatically shuts down equipment when a severe power disruption occurs. For peripheral equipment, these devices are recommended but optional.
- Online UPS—Maintains constant input voltage for devices and should be considered if outages of one-half cycle or more are common. For each situation, consult a qualified contractor or consultant.

You can protect the MCS-200/100 from the sources of many electrical disturbances by using:

- An isolated power distribution system
- Power conditioning equipment
- Over- and under-voltage detection and protection circuits
- Protection to reduce high-frequency electrical energy radiation
- Surge protective devices on power cables to protect equipment against electrical storms

# Electrical planning around water-handling components

**CAUTION:** In case water is in contact with the power cables, shut down the main breaker before cleaning up water in this area.

Because of potential condensation on non-insulated water connections or leaking water connections around water-based cooling systems, consider the following during the electrical planning:

- Waterproofed connectors
- Watertight conduits for cables
- Leak detection systems

To identify waterproofed connectors, HP recommends that you use the IP rating of the connector based on the international standard IEC 60529. HP recommends a connector that is rated at least IP 67.

Cable conduits are available in different styles, depending on flexibility and materials. The most common materials are plastic, metal, nylon, or a composition of these materials. Watertight conduits are available in both flexible and hard material, depending on the application.

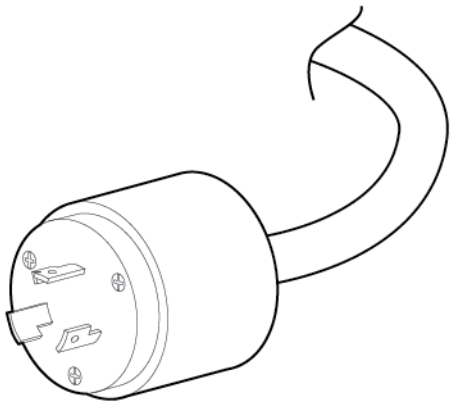
A leak detection system for a data center usually uses leak sensor cables, which are installed on the subfloor in a raised floor and connected to a facility management system.

# Connecting to facility A/C power

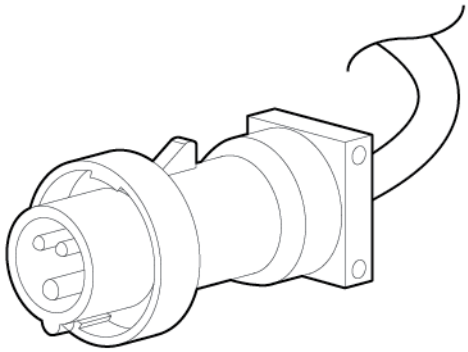
The MCS-200/100 accepts AC power through two Walther Procon A5 series power receptacles located at the top rear patch panel. If available, the MCS-200 ships with one of each AC power cord set for connecting to redundant AC power busses. The NEMA L6-20 power cord uses a NEMA L6-20 male plug for connecting to a facility AC feed connector common to North America and Japan. The IEC 309 power cord uses an IEC 309 male plug for connecting to a facility AC feed connector common in various international regions.

These redundant connections and cords are optional for the MCS-100.

MCS-200/100 power L6-20 connector



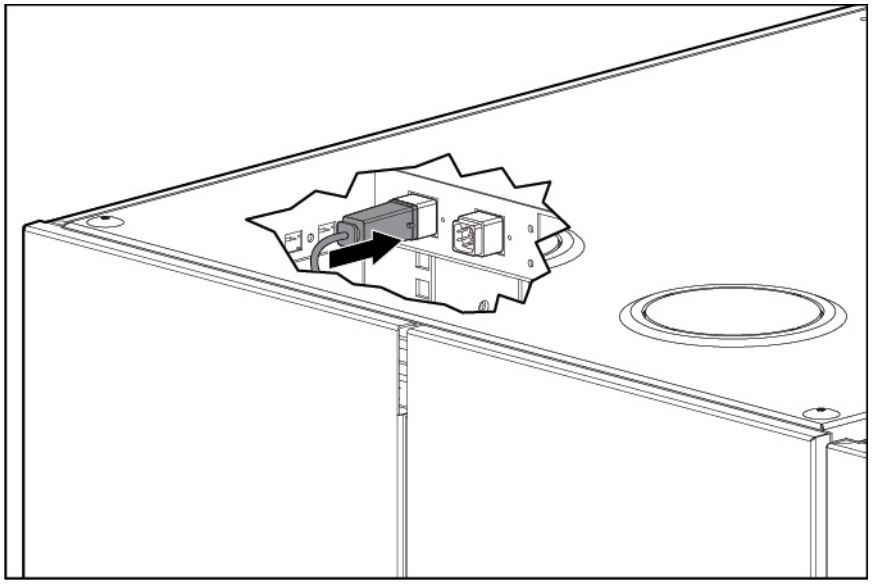
MCS-200/100 IEC 309 power connector



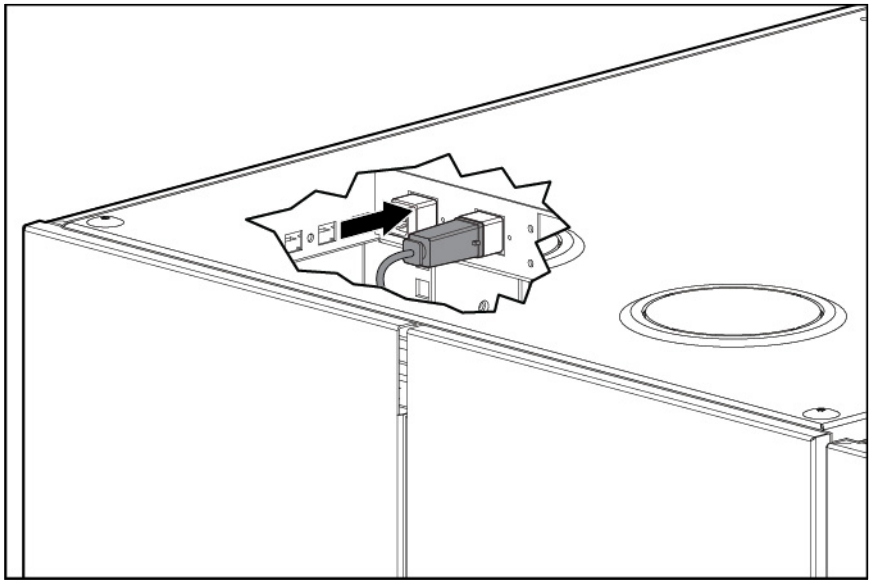
At least one power cord must be used for MCS-200/100 operation. To improve system availability, the second cord can connect to a redundant AC power bus (optional for the MCS-100). When the redundant power is connected, the transfer switch assembly of the MCS-200/100 provides switch-over to the active power bus, in the event of power source failures or accidentally tripped circuit breakers.

The power cords of the MCS-200/100 are 4 m (13.1 ft) long. The power connections are inside of the top of the IT rack as shown in the following figures.

When using only a single, primary source for power, the AC power cord is connected to the left-most receptacle.



When redundant AC power is available, the redundant AC power cord is connected to the right receptacle.



# Coolant source planning

△ **CAUTION:** The minerals and chemicals typically found in tap water can react with metallic elements used in the HP Modular Cooling System 200/100 closed-loop distribution system. Electrochemical reactions can cause scaling, corrosion, leaks, and blockage, ultimately resulting in reduced efficiency of the cooling system and even damage.

A number of factors relating to a facility water distribution system must be considered during the site preparation process, including the following:

- Redundant water configurations. For more information, see Appendix B: Conversion factors and formulas (on page 85).

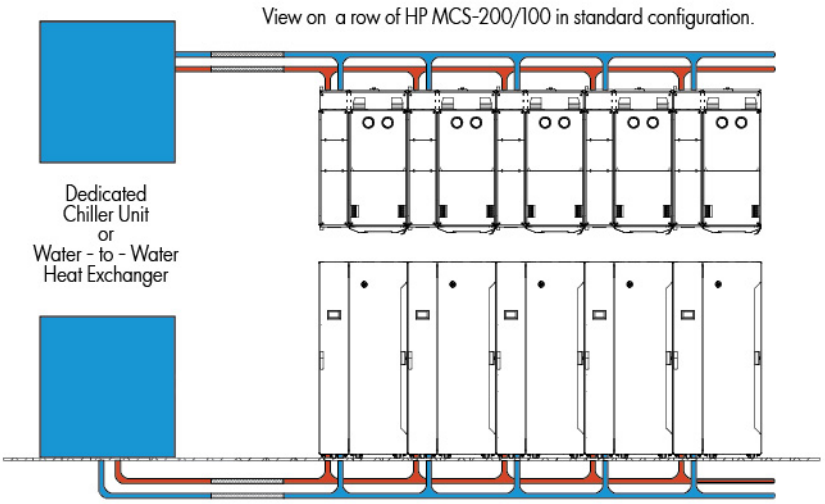
- The water source should be shared water or dedicated facility water loop.
- Maximum and minimum temperatures of building chilled water plant, and target chilled water temperature of dedicated loop, should be based on the total cooling capacity required and planned.
- The viscosity of the chilled liquid, combined with the length and elevation changes in piping determined by selected route, can affect pipe size selection.

For the MCS-200/100, HP recommends using a water source that is a dedicated chiller unit or water-to-water heat exchanger that enables line isolation, better control of individual systems, and regulated water quality. The chilled water source for this loop is provided by one or more chiller systems. Advantages of using a dedicated loop include the following:

- Easier scheduling of maintenance to either a building system or dedicated MCS-200/100 loop
- Easier maintenance of water quality parameters in the dedicated closed loop
- Better temperature and flow regulation to guarantee the needs of the MCS-200/100
- More flexibility to regulate water temperature in order to reduce the potential for condensation

The use of building-chilled water for the MCS-200/100 unit is possible under certain conditions. Consult with a qualified facilities design expert, however, to determine whether this approach is possible within your specific data center. Refer to the requirements for water quality, temperature, and flow rate described in this section. Regardless of chilled water service approach, consult with a qualified facilities design expert to analyze new and existing systems and specify new work to be sure that water quality, temperature, and water flow requirements can be met. The new work must meet all local safety and building code requirements as well as your facility quality standards. Piping drawings and schematics included here are diagrammatic to convey a conceptual understanding of the MCS-200/100 connection requirements.

Dedicated chiller unit directly supplying the MCS-200/100




# Plumbing considerations

When installing the MCS-200/100, consider the following plumbing factors:

- Installing water shut off valves to enable infrastructure system flushing for the inlet and outlet of each MCS-200/100 (highly recommended by HP)

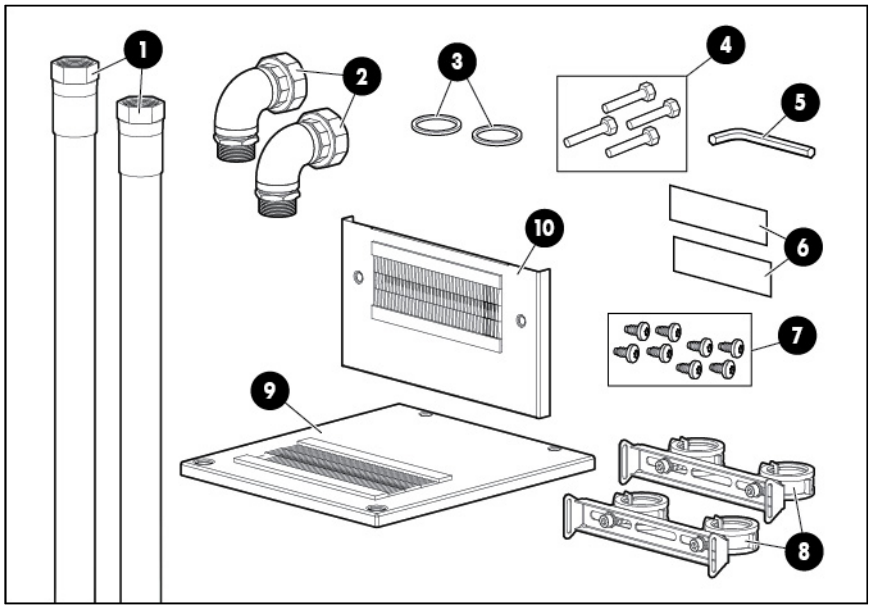
- Flow rate and pressure capacity of chilled water plant input to the design of the facility feed line and dedicated water loop pipe diameters
- Material compatibility within piping system to minimize the potential for electrochemical corrosion, and must be corrosion-resistant
- Minimization of elbows and other restrictions that increase flow resistance
- Insulation of piping to minimize risk of condensation and reduce incidental heating of supplied chilled water
- Availability of a floor drain or reclamation system to capture system condensation
- Structural securing of piping to support weight of distribution network filled with water
- Water quality management, including particulate filtration, treatment, and flushing provisions, with isolation valves for service requirements
- Availability and access to a data center leak detection system to monitor the infrastructure system for leaks
- Air vents installed at the highest point in the pipe system

  Each MCS-200/100 has an air vent, but additional vents in the supply piping system must be considered.

## HP Water Hook-Up Kit

HP recommends using the MCS-200/100 Water Hook-up Option Kit BW971A, available on the HP website (http://www.hp.com), to connect the MCS-200/100 to a facility chilled water system. Each kit includes the hoses and accessories required for connecting the facility supply and return lines to the main inlet and outlet connections of an MCS-200/100 unit and must be installed prior to the delivery of an MCS-200/100.

**MCS-200/100 Water Hook-Up Option Kit contents**




| Item | Description (quantity) |
|---|---|
| 1 | Main hose assembly* (2) |
| 2 | 90-degree elbow assembly (2) |
| 3 | Teflon gasket (2) |

| Item | Description (quantity) |
|---|---|
| 4 | M6 screw (4) |
| 5 | 5mm Hex L-key (1) |
| 6 | Warning label (2) |
| 7 | M5.5 x 10 self-tapping screw (8) |
| 8 | Hose mounting brackets with hose clamps (2) |
| 9 | Top cover plate (1) |
| 10 | Rear cover plate (1) |

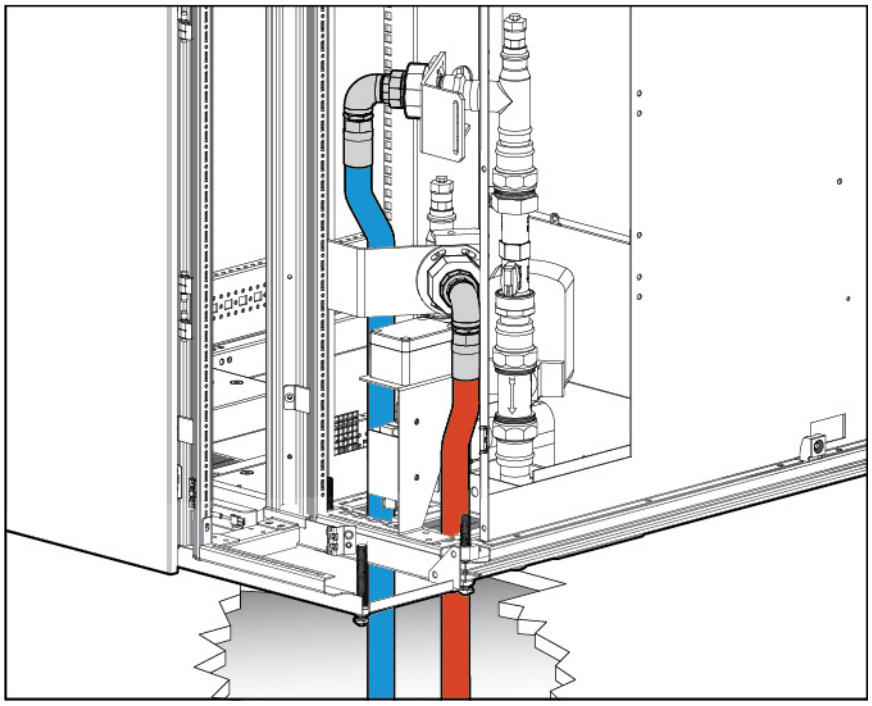
*Not drawn to scale. The actual length of the main hose is approximately 3.5 m (11.5 ft).

△ **CAUTION:** You must properly connect the cabinet and facility cool water inlet and warm water outlet hoses. The MCS-200/100 does include a check valve to prevent the reverse flow of coolant.

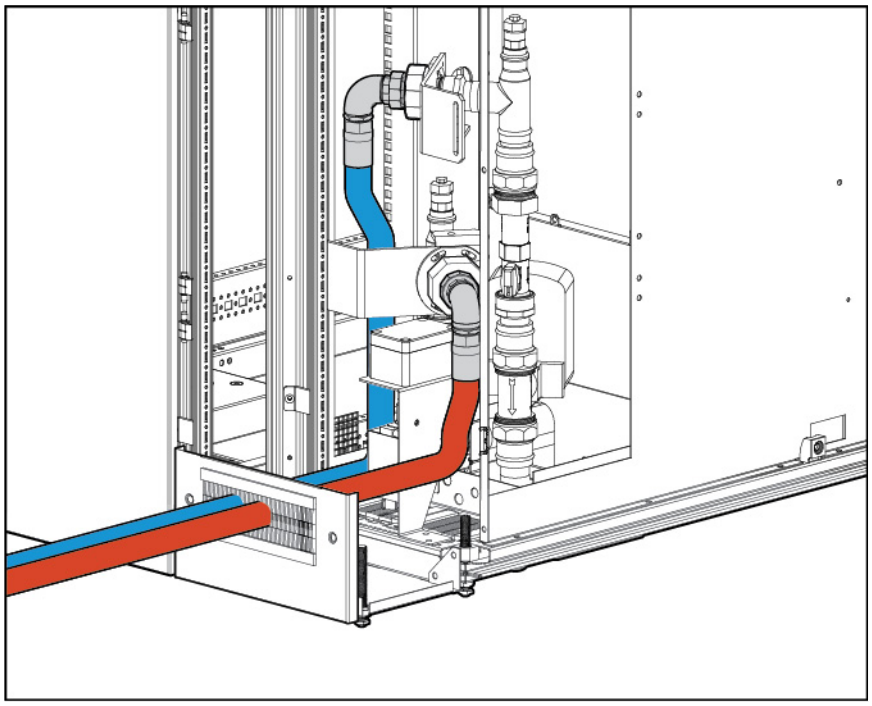
The MCS-200/100 has the connecting fittings inside the unit, approximately 600 mm (24 in) above the floor on the rear side. It allows the main coolant hoses to be routed either down through the cutouts in a raised floor, as per HP recommendation. The main coolant hoses can also be routed up through openings in the top of the cabinet and above the unit, or through the back of the cabinet and above the floor (for MCS-200 only). The left (blue) hose designates the chilled water supplied to the MCS-100 and the right (red) hose designates the warm water exiting from the MCS-200/100.

**Main coolant line hookup options for the MCS-200/100**

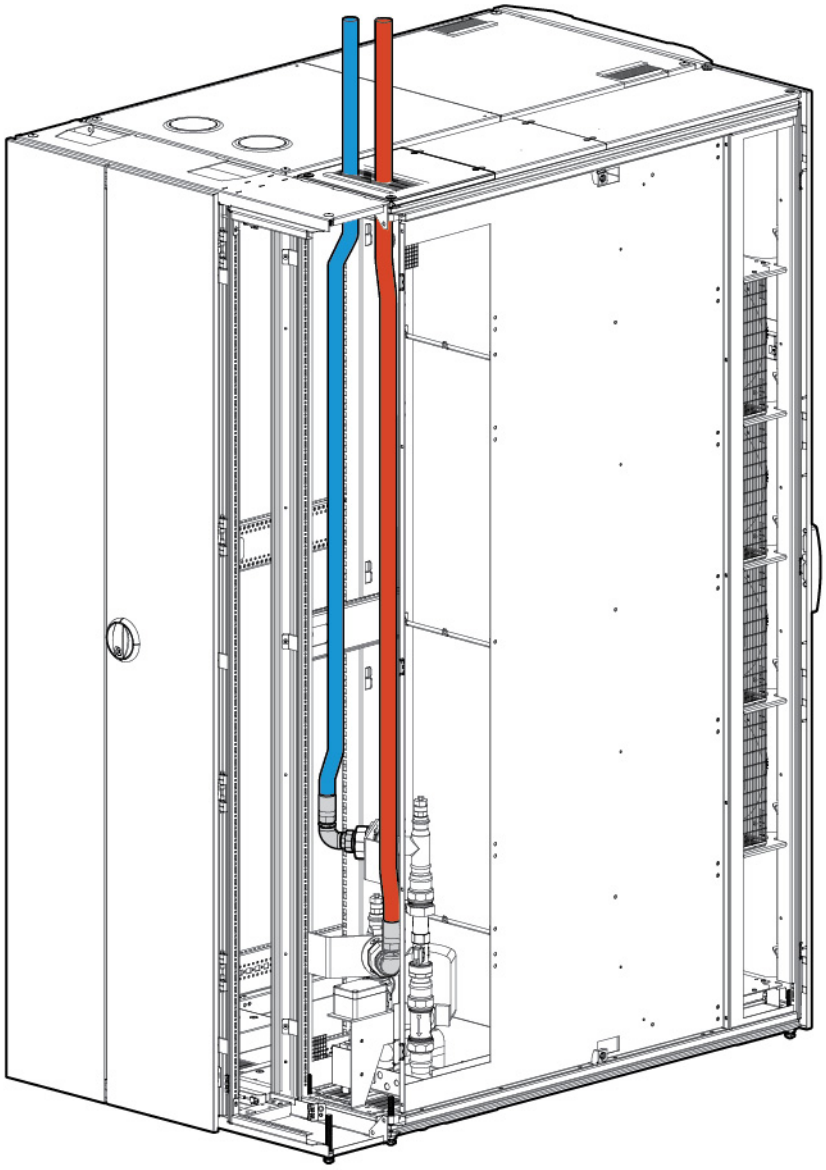
- Through raised floor cutouts



- Above the floor (for MCS-200 only)



- Above the unit



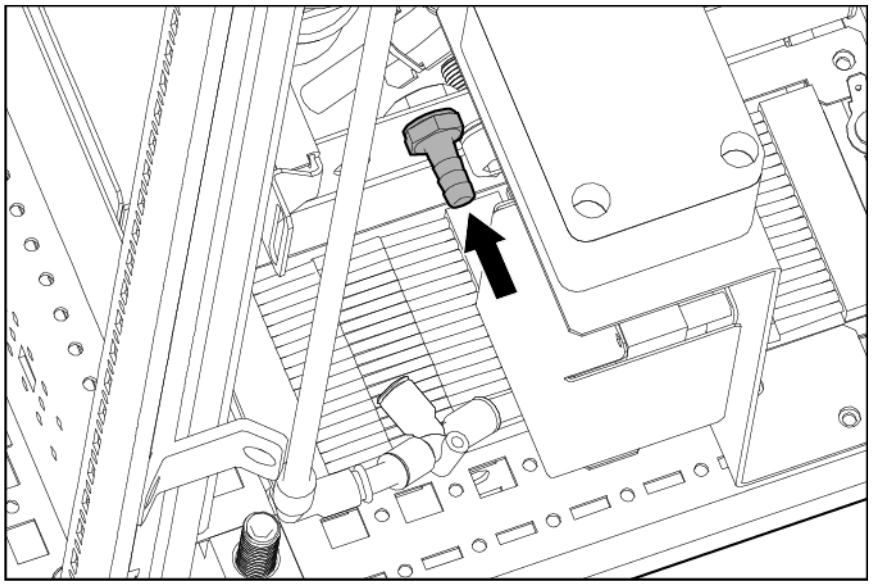
An HP Water Hook Up Kit must be installed prior to activating an MCS-200/100. The kit contains approximately 350 cm (138 inches) of flexible hose with terminated fittings on each end. The length that is available outside the MCS-200/100 depends on the preferred type of connection.

**Available hose lengths outside the MCS-200/100 by connection type**

| Connection type | Approximate length supply hose | Approximate length return hose |
|---|---|---|
| Bottom | 280 cm (110 inches) | 300 cm (118 inches) |
| Rear | 280 cm (110 inches) | 300 cm (118 inches) |
| Top | 200 cm (79 inches) | 180 cm (71 inches) |

The following figure shows the location of the condensate and overflow in the rear of the cooling unit. The MCS-200/100 includes both tubes for the hookup. Each tube is approximately 3 m (9 ft) in length. The overflow hose has an inner diameter of 9 mm (0.35 inch) and the condensation hose has an outer diameter

of 8 mm (0.31 inch). The preferred method of routing for all hoses is downward at an angle of at least 3° (pitch of 0.6 inch per 12 inches), without loops, and away from the MCS-200/100 cabinet. For MCS-200 only, pumped condensation and gravity-fed overflow hoses must be routed to a floor drain or reclaim system.



Flexible attachment hoses are intended to allow for deflection in any direction for equipment mounted on dynamic platforms, or for slight relocation of cabinets. Installation service for this MCS-200/100 is order number UE005E.

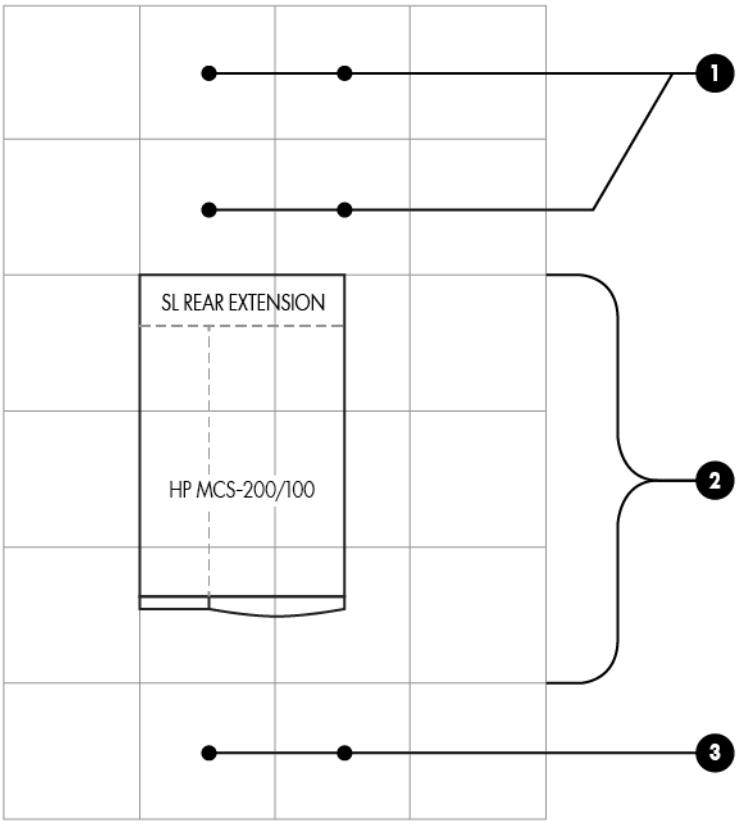
# Piping approaches

HP recommends the following methods for facility plumbing orientation of the MCS-200/100:

- Direct rear approach
- Left rear approach
- Right rear approach

You can approach the MCS-200/100 from the front with piping for the top and bottom connection. This approach, however, requires careful planning for accessible component locations and hose attachments.

The following figure shows the recommended facility piping approaches to the MCS-200/100.



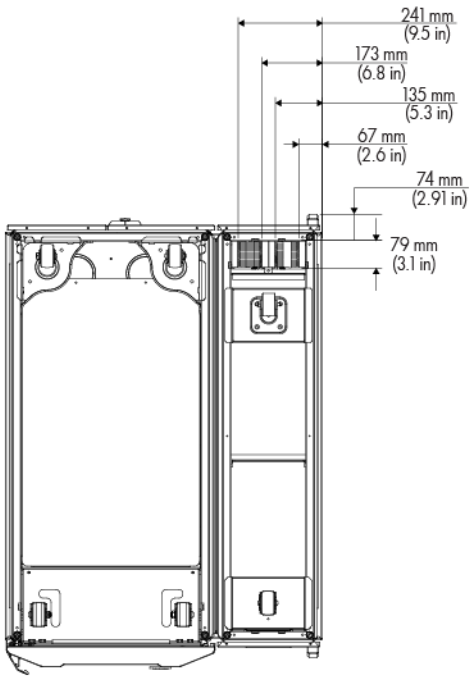

| Item | Description |
|---|---|
| 1 | Preferred piping location: locate chilled water piping taps behind the MCS-200/100—either under or above the floor. Chilled water taps must approach laterally. |
| 2 | Do not locate piping connections or components under the MCS-200/100. |
| 3 | Alternate piping location: locating chilled water piping taps in front of the MCS-200/100. Under the floor is possible. This option requires careful planning due to the chilled water hose length limitation. |

# Hose openings

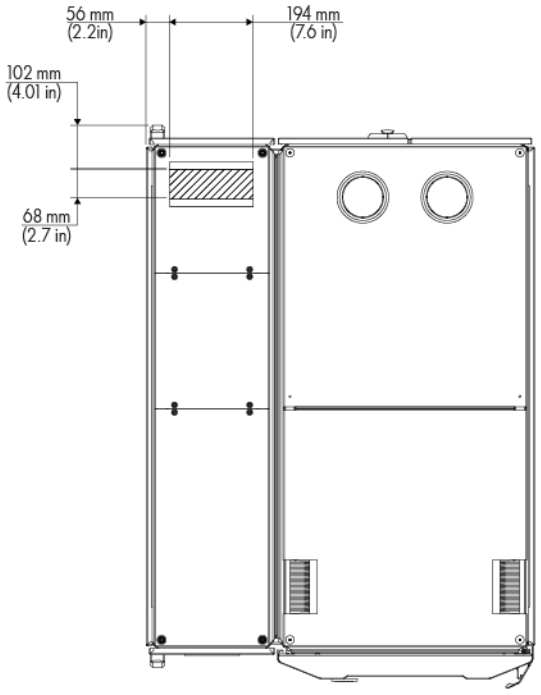
The following figures show the dimensions and locations of the various hose openings of the MCS-200/100.

**MCS-100 hose openings**

- Bottom view

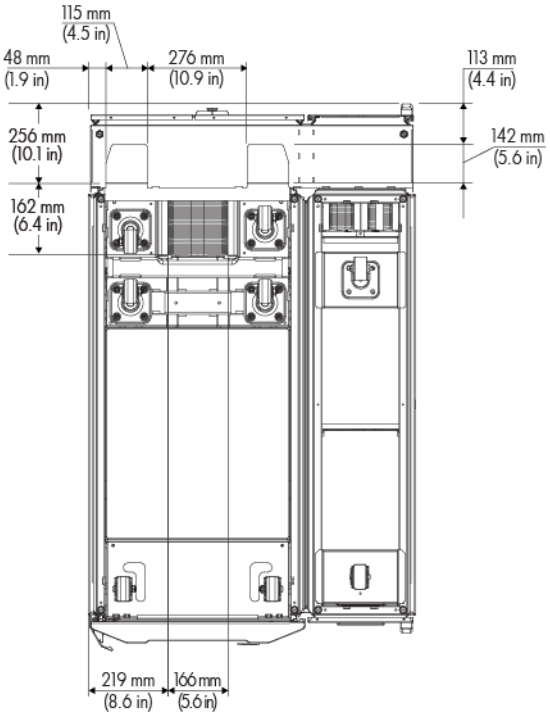



- Top view

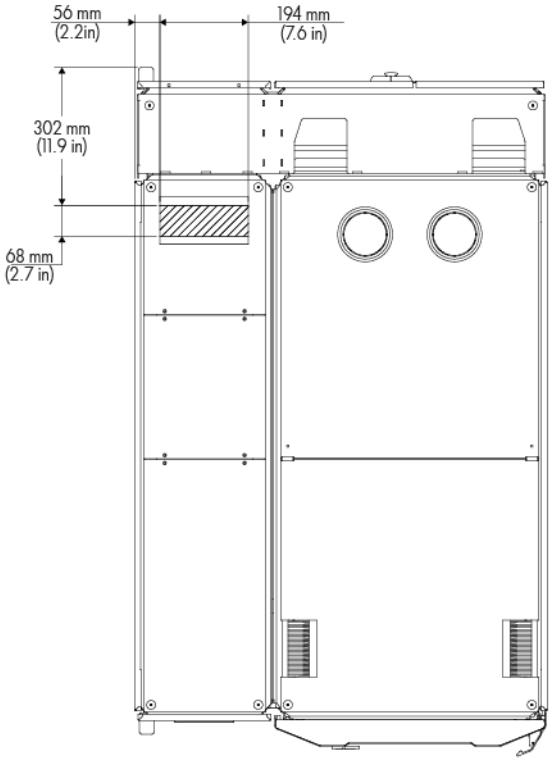



**MCS-200 hose openings**

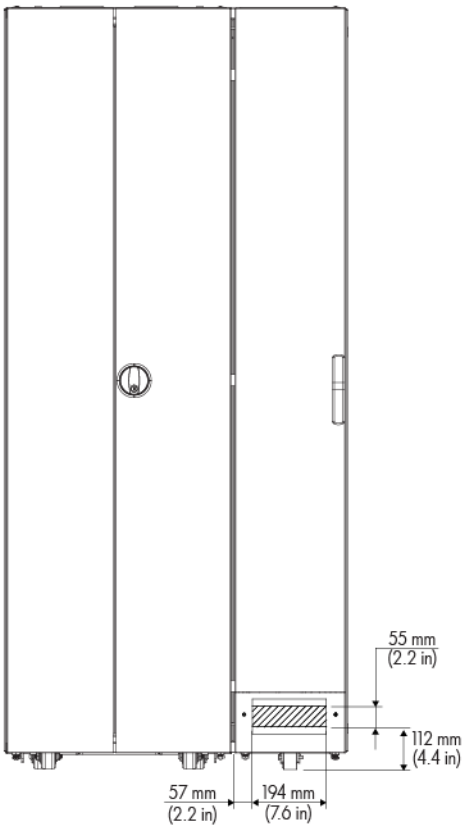
- Bottom view




- Top view



- Rear view




# Raised floor cutouts for the MCS unit

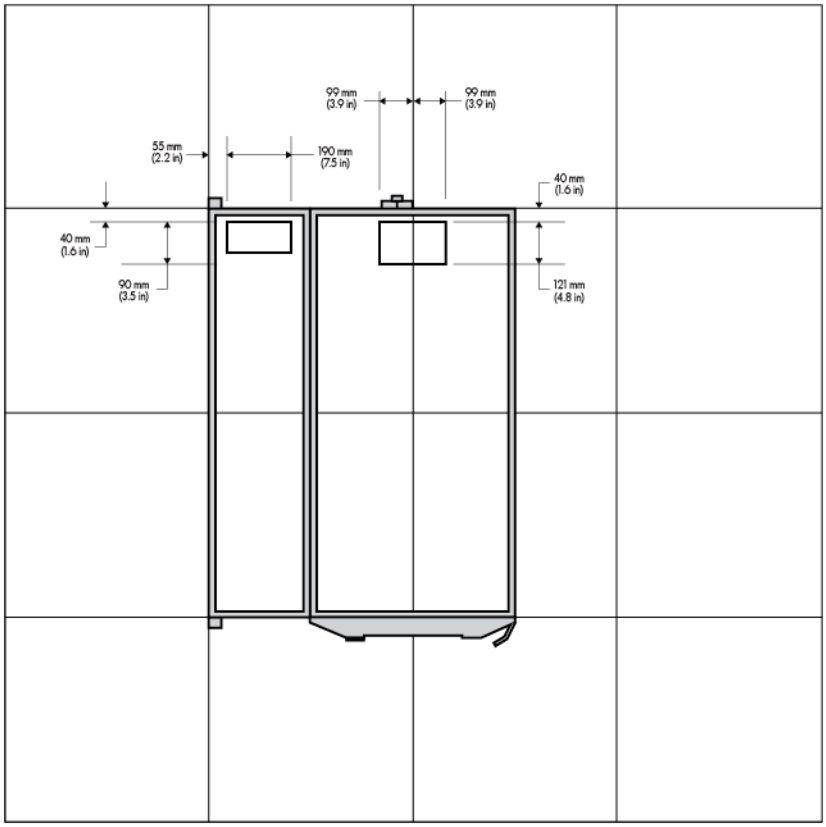
A complete MCS-200/100 installation typically requires the following floor cutouts in a raised-floor facility (standard rack configuration):

- One floor cutout for the chilled water hoses and drain hoses of the cooling unit
- One floor cutout for the power cords and data cables of the computer equipment rack, including power supply to the MCS-200/100. For more information on the top openings, see "Cable openings (on page 26)."

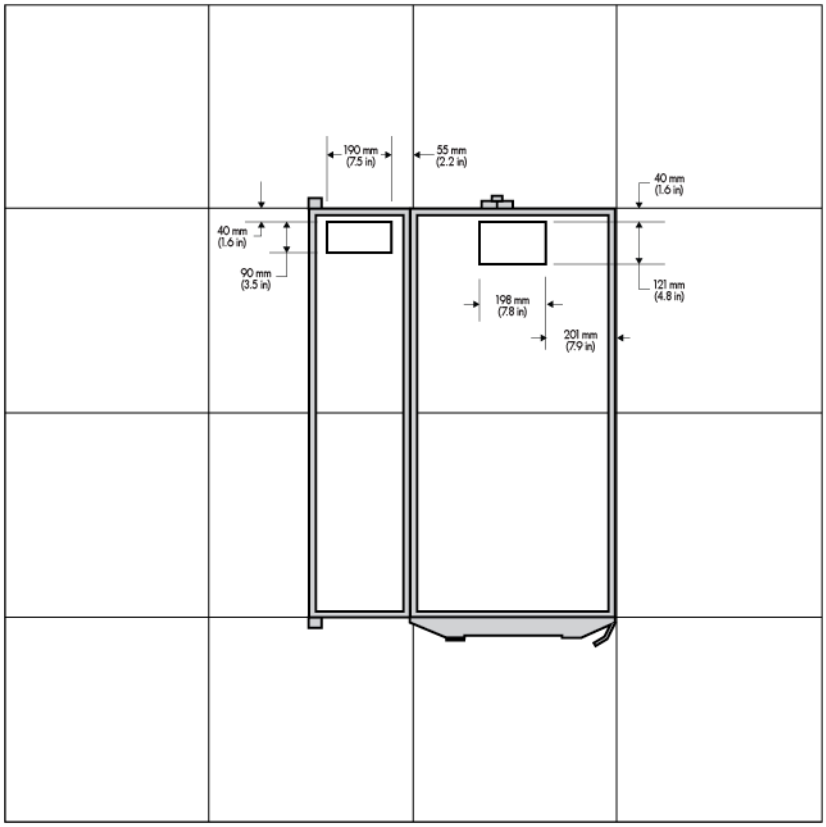
Raised floor panels vary in size globally but create virtual grid lines or seams where panels come together. These seams are ideal for positioning computer racks on the raised floor. The following figures reference the locations of rack attributes aligned with raised floor seams to provide critical dimensions for floor cutouts.

**MCS-100 floor tile cutouts**

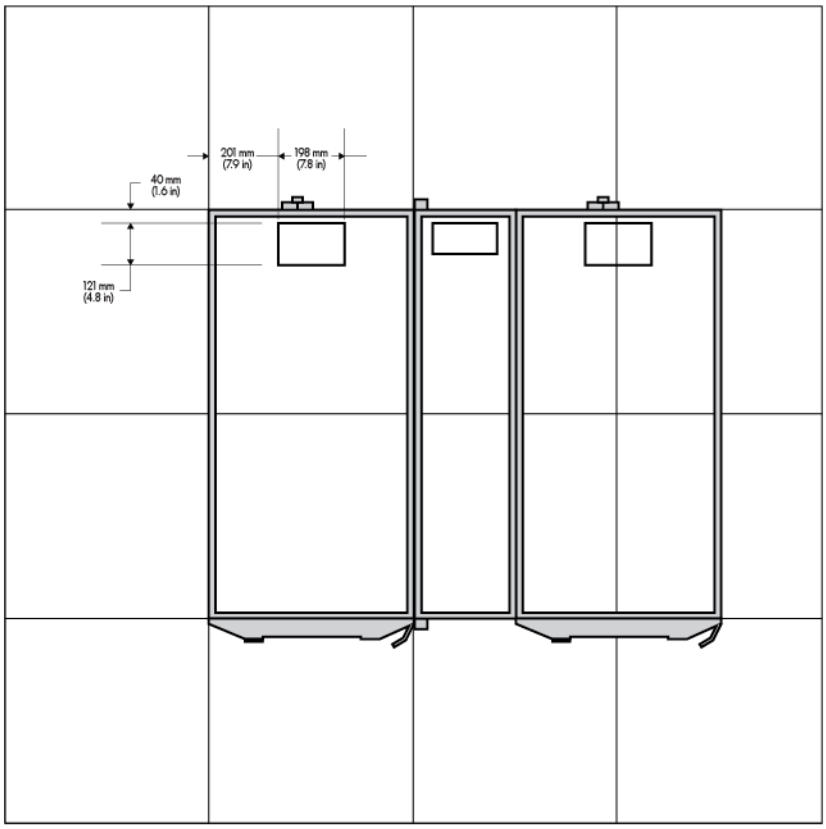
**Recommended floor cutouts (single rack configuration)—Option 1 (MCS-100 cooling unit side flush to tile)**



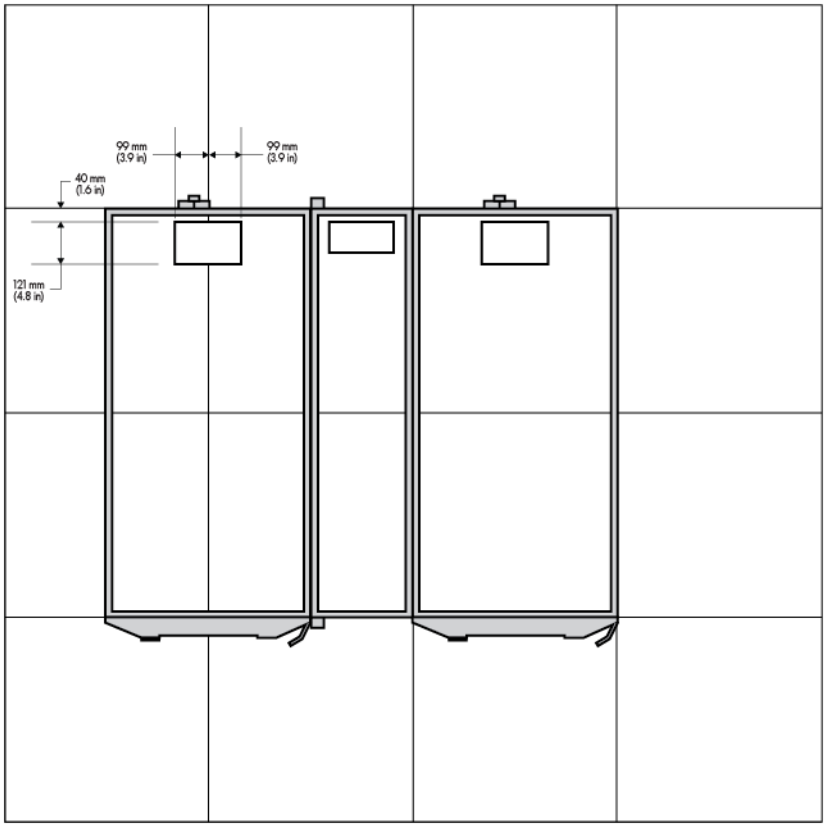
**Recommended floor cutouts (single rack configuration)—Option 2 (MCS-100 rack side flush to tile)**



**Recommended floor cutouts (dual rack configuration)—Option 3 (MCS-100 cooling unit side to tile)**

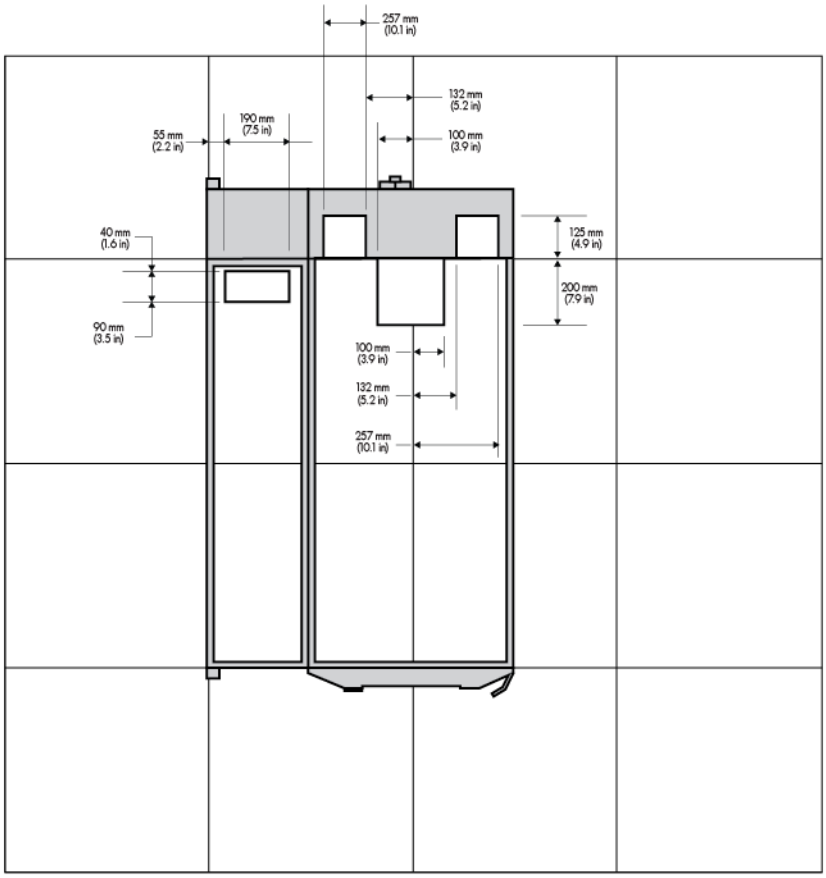


**Recommended floor cutouts (dual rack configuration)—Option 4 (MCS-100 right side to tile)**

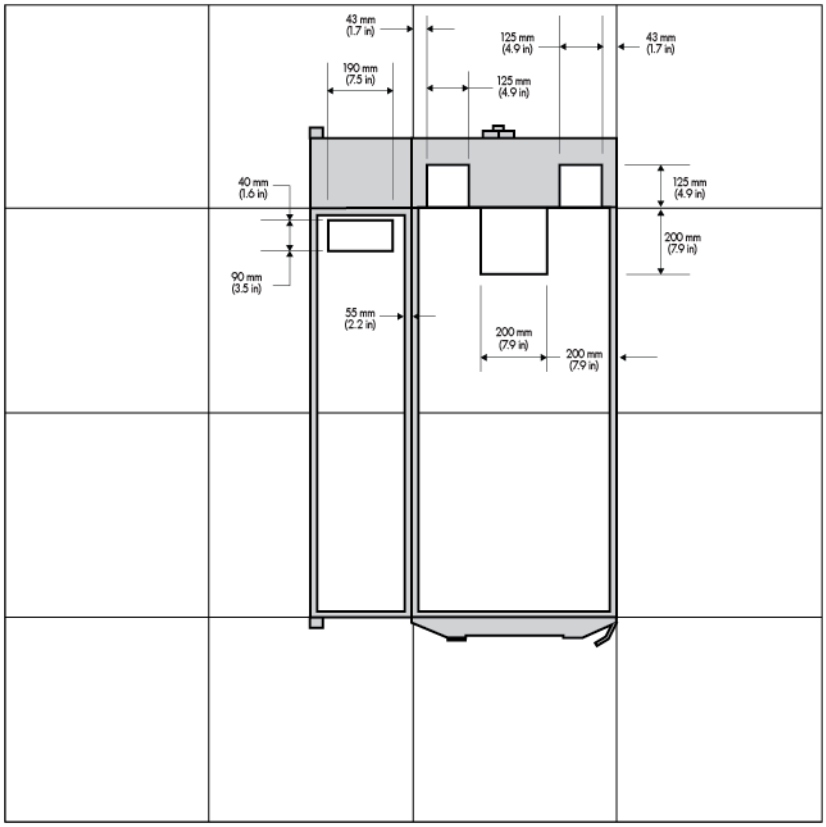



**MCS-200 floor tile cutouts**

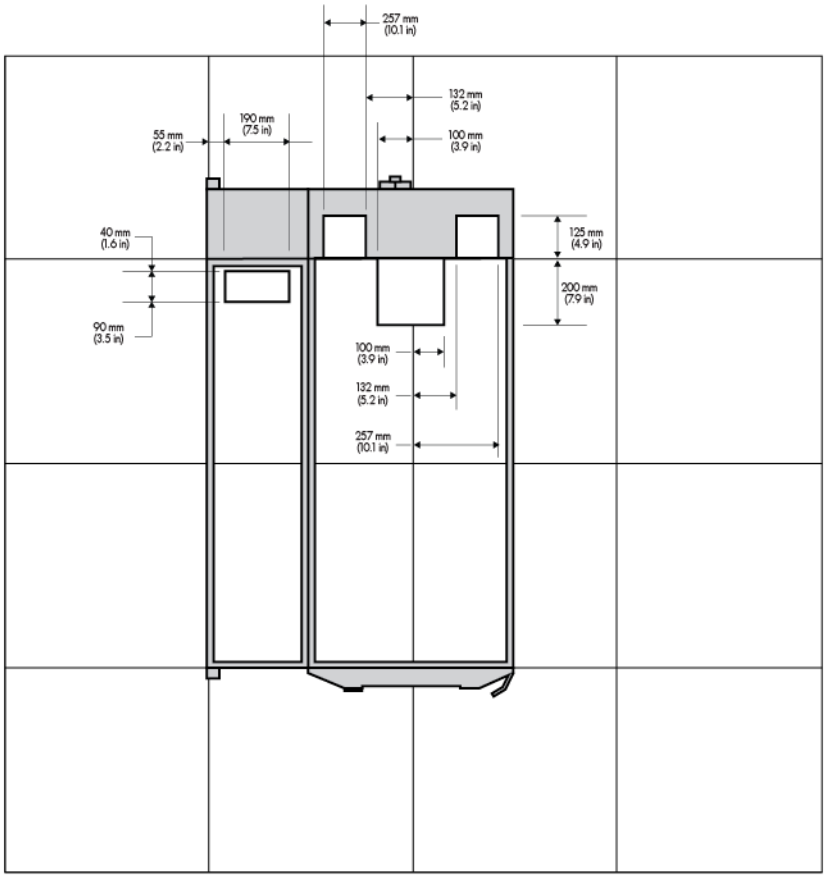
**Recommended floor cutouts (single rack configuration)—Option 1 (MCS-200 cooling unit side and front flush to tile)**



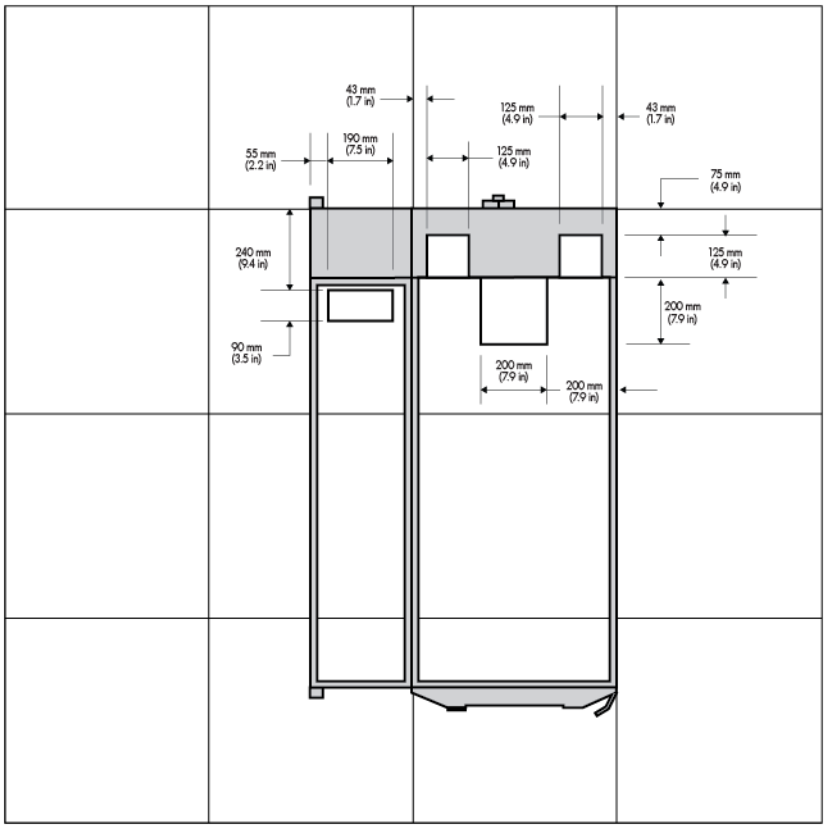
**Recommended floor cutouts (single rack configuration)—Option 2 (MCS-200 rack side and front flush to tile)**



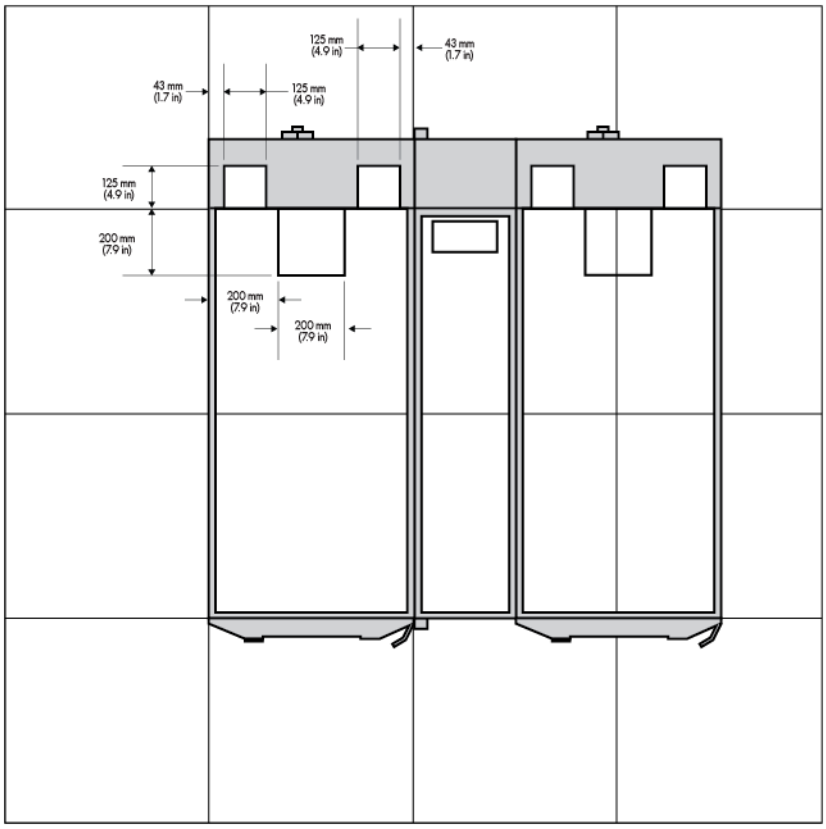
**Recommended floor cutouts (single rack configuration)—Option 3 (MCS-200 cooling unit side and rear flush to tile)**



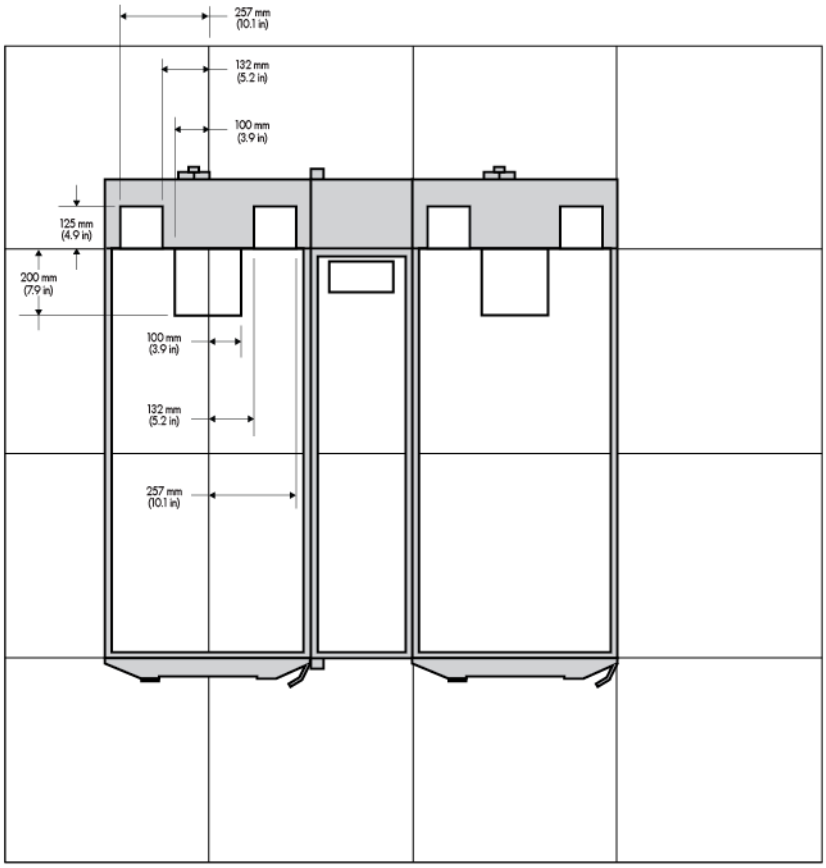
**Recommended floor cutouts (single rack configuration)—Option 4 (MCS-200 cooling unit side and rear flush to tile)**



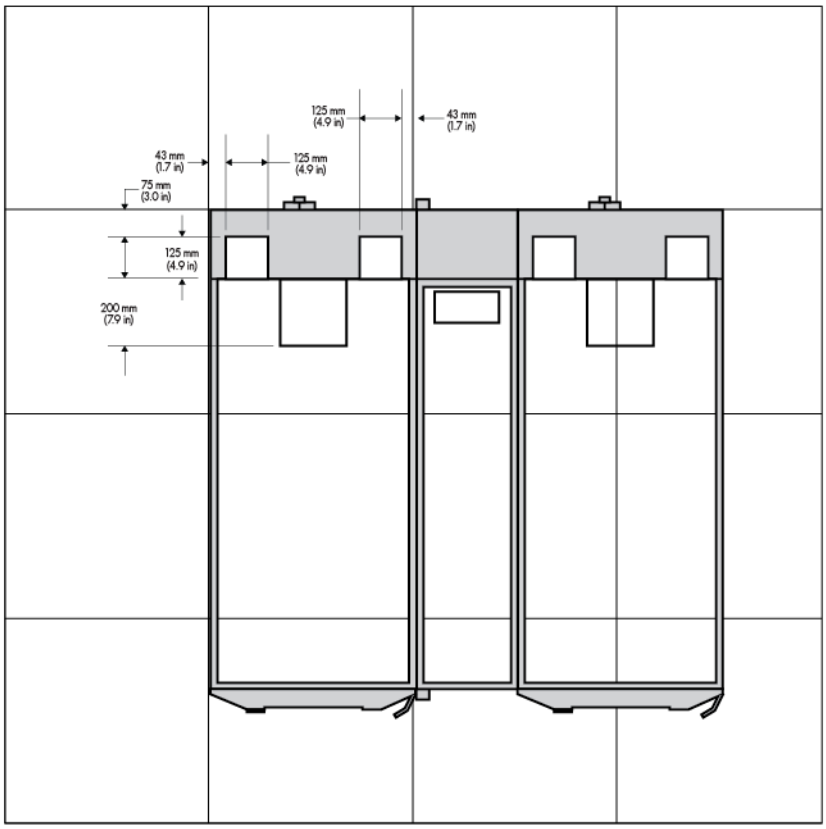
**Recommended floor cutouts (dual rack configuration)—Option 5 (MCS-200 cooling unit side and front flush to tile)**



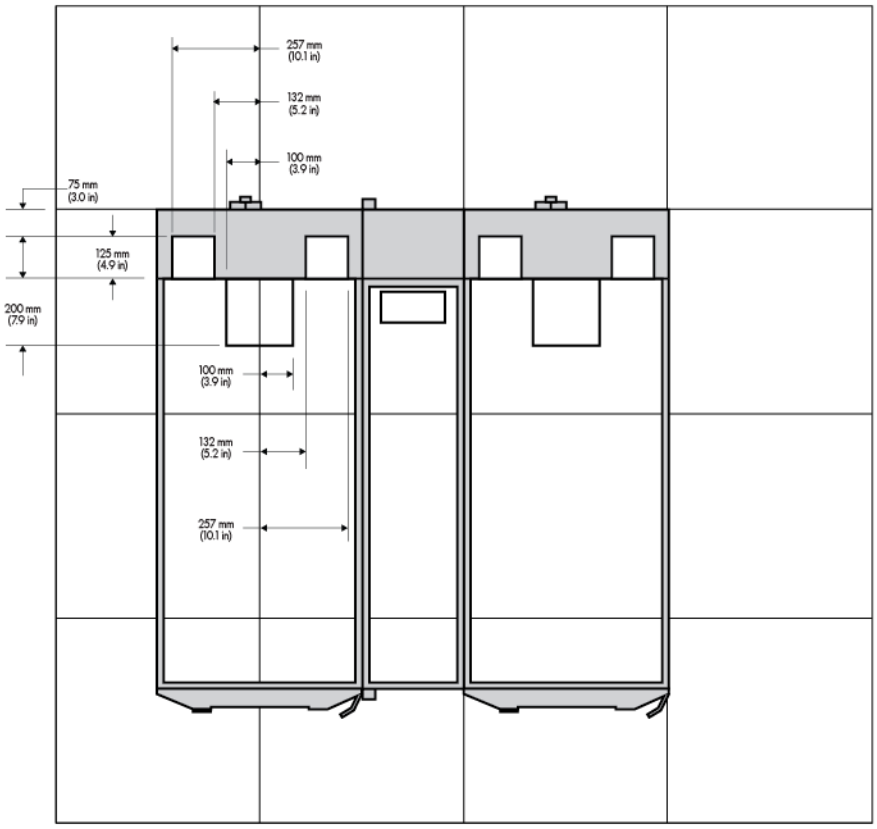
**Recommended floor cutouts (dual rack configuration)—Option 6 (MCS-200 rack side and front flush to tile)**



**Recommended floor cutouts (dual rack configuration)—Option 7 (MCS-200 cooling unit side and rear flush to tile)**



**Recommended floor cutouts (dual rack configuration)—Option 8 (MCS-200 cooling unit side and rear flush to tile)**

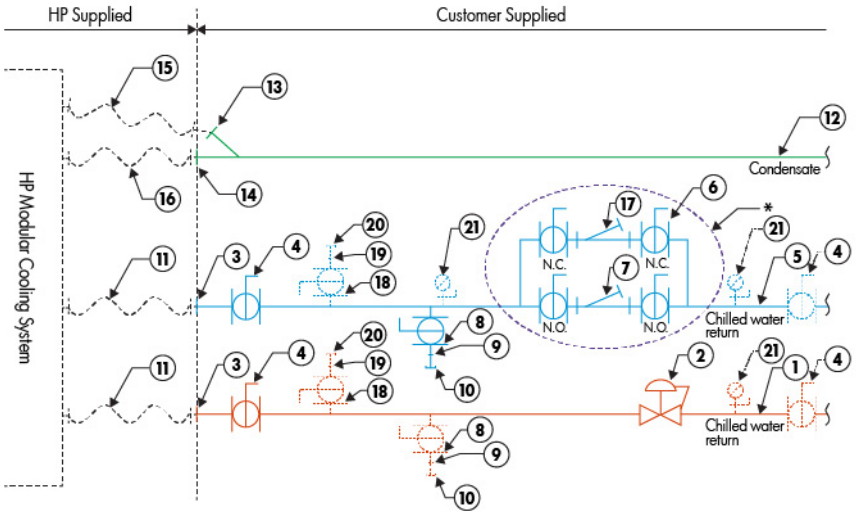



A wider opening in the back of the IT rack is optional with MCS-200. The floor tile sizes used in the above options are 600 mm x 600 mm (23.6 inches x 23.6 inches). Floor tile sizes vary. The allowable tolerances are +/- 3.2 mm (+/- 0.125 inch). When installing multiple MCS-200/100 units in a row, you must consider the tolerances as you plan the cutouts.

# Chilled water system components

Chilled water supply and return service are required for each MCS-200/100 in order to have a particular combination of components for peak performance. These components are identified in the following figures and tables. Components drawn with a solid line are strongly recommended. Components drawn with dotted lines are advisable for a higher availability and serviceability.

### Recommended plumbing configuration for the MCS-200/100




### Typical plumbing components for an MCS-200/100 configuration

| Item | Description | Specifications |
|---|---|---|
| 1 | Chilled water return line | Pipe: 31.75-mm (1.25-inch), ASTM B 88, Type L, hard-drawn copper<br>Fittings: ASTM B16.22 Wrought copper<br>Solder: ASTM B 32, 95-5 Tin Antimony<br>Thread sealant: seal and assemble according to local materials and practices |
| 2 | Flow/measurement balancing valve | Valve type: 31.75-mm (1.25-inch) bronze balancing valve, ball design, with positive shutoff, integral checked metering ports, adjustable knob, memory device, calibrated nameplate, integral drain port, and solder end connections<br>Position: horizontal run of pipe<br>Orient drain port toward MCS-200/100. Avoid fittings closer to measurement valve than five pipe diameters upstream and two pipe diameters downstream for maximum performance.<br>Watts CSM-61 or equivalent, typical 1 |
| 3 | Pipe | 31.75 mm (1.25 inches) copper, male (NPT or BSPP) adapter to connect the MCS-200/100 water hoses, typical 2 |
| 4 | Isolation valves | Valve type: 31.75-mm (1.25-inch), two-piece, full-port, brass ball valve, with chrome plated brass ball, PTFE seats, steel handle, with female connections and 31.75-mm (1.25-inch) bushing on the end toward MCS-200/100 hoses.<br>Pressure rating: 600 psi WOG, 150 psi WSP<br>Watts FBV-3C or equivalent |
| 5 | Chilled water supply line | Pipe: 31.75-mm (1.25-inch), ASTM B 88, Type L, hard-drawn copper<br>Fittings: ASTM B16.22 Wrought copper<br>Solder: ASTM B 32, 95-5 Tin Antimony<br>Thread sealant: Seal and assemble according to local materials and practices |

| Item | Description | Specifications |
|---|---|---|
| 6 | Strainer isolation valves | Valve type: 31.75-mm (1.25-inch), two-piece, full-port, brass ball valve, with chrome plated brass ball, PTFE seats, steel handle, with solder end connections.<br>Pressure rating: 600 psi WOG, 150 psi WSP<br>Orientation: Stem vertical up for lateral level operation. Offset valves on CHWS and CHWR piping to prevent interference from lever actuators when closed.<br>Watts FBVS-3C or equivalent<br>typical 4 |
| 7 | Strainer | Type: 31.75-mm (1.25-inch) wye-patterned bronze strainer, with #30 stainless steel wire mesh liner, ¾-inch tapped retainer cap & gasket, and solder end connections. Provide 19.05 mm (0.75 inch) ball valve for blowdown with cap and chain.<br>Pressure rating: 400 psi WOG, 125psi WSP<br>Orientation: with basket and blowdown valve directed down<br>Watts S777 or equivalent |
| 8 | System drain valve | Type: 19.05-mm (0.75-inch) two-piece, full-port, brass ball valve with chrome plated brass ball, PTFE seats, and steel handle, with threaded connections.<br>Pressure rating: 600 psi WOG, 150 psi WSP<br>Watts FBV-3C or equivalent |
| 9 | Nipple | Type: 19.05-mm (0.75-inch) brass close nipple |
| 10 | Cap | Type: 19.05-mm (0.75-inch) brass cap with chain |
| 11 | Hose | Type: 1.25-inch flexible hose supplied with MCS-200/100 Water Hook-up Kit. |
| 12 | Condensate line | Pipe: 19.05-mm (0.75-inch) copper or Schedule 40 PVC<br>Fittings: Wrought Copper or Schedule 40 PVC<br>Orientation: Sloping downward in a minimum angle of 1° (0.25 inch per 1 ft) and away from the MCS 5042 for gravity drain |
| 13 | Compression fitting | Type: 6.35-mm (0.25-inch) male NPT X 8 mm (0.31-inch) compression fitting, Parker Hannifin, FBMB8-1/4 Metrulok fitting, Festo QB-1/4-5/16-U or equivalent and installed by plumbing contractor, typical 1 |
| 14 | Hose barb | Type: 12.7-mm (0.50-inch) ID hose barb x 0.75-inch male NPT, Parker Hannifin, 125HBL-8-12, fitting or equivalent and installed by plumbing contractor, typical 1 |
| 15 | Hose | Type: 8-mm (0.31-inch) OD flexible hose supplied with MCS-200/100 |
| 16 | Hose | Type: 9-mm (0.35-inch) ID flexible hose supplied with MCS-200/100 |
| 17 | Filter* | HP recommends 1µm filter for optimal long-term performance of the MCS-200/100 cartridge or bag filter could be used in a full flow or side stream flow configuration. Watts FM4X2 stainless steel housing or equivalent. Provide dielectric unions on both connections. Provide pleated cartridge rated for 1 µm. Depending on water quality, multiple units in parallel might be required. |
| 18 | Manual air vent | Type: 19.05-mm (0.75-inch) two-piece, full-port, brass ball valve with chrome plated brass ball, PTFE seats, and steel handle, with threaded connections.<br>Pressure rating: 600psi WOG, 150psi WSP<br>Watts® FBV-3C or equivalent |
| 19 | Nipple | Type: 19.05-mm (0.75-inch) brass close nipple |
| 20 | Cap | Type: 19.05-mm (0.75-inch) brass cap with chain |

| Item | Description | Specifications |
|---|---|---|
| 21 | Test plug | Type: Corrosion-resistant brass body with core inserts, gasketed and threaded cap, with extended stem for units to suit piping insulation thickness<br>Watts TP or equivalent |

*The 1µm filter might require a minimum of 762 mm (30 inches) clearance under the floor for installation. If a filter cannot be installed under the roof because of space constraints, it may be installed further upstream in the pipe system.

# Typical plumbing installation guidelines

△ **CAUTION:** The water supply system feeding the HP Modular Cooling System 200/100 must be capable of withstanding operation with rapid and frequent changes in flow requirements.

- Installation service for this MCS-200/100 is order number UE005E.
- Contractors must install all valves, strainers, and other piping components to the specifications provided in "Piping approaches (on page 51)." All components must be readily accessible.
- Contractor must flush all lines of debris and cap prior to MCS-200/100 installation.
- Contractors must furnish and install Armacell AP/Armaflex closed-cell elastomeric thermal insulation with minimum 25-mm (1-inch) wall thickness on all customer piping and fittings. Contractors shall furnish and install similar insulation type with minimum 6.4-mm (0.25-inch) wall thickness for MCS-200/100 chilled water hoses and fittings. The MCS-200/100 hoses have a 45-mm (1.75-inch) OD and a bolt clamp that is 76 mm (3 inches) wide, 57 mm (2.25 inches) high, and 51 mm (2 inches) deep on the side that must be connected to the infrastructure pipe. All insulation joints must be taped with AP/Armaflex® Insulation Tape, 3 mm (0.125 inch) thick x 50 mm (2 inches) wide x 9.1 m (30 ft) long. Mitered fittings must be cemented with Armaflex® 520 Adhesive.
- MCS-200/100 condensate and overflow hoses do not require insulation.
- Filters might require a minimum of a 762-mm (30-inches) clearance under the floor for installation. If the filters cannot be installed under the floor due to space constraints, they can be placed upstream of the piping system.

HP recommends that the MCS-200/100 Hook Up Kit (BW971A) be ordered for each MCS-200/100 installed.

The water supply system feeding the MCS-200/100 must capable of withstanding the following situations:

- Deadheading—operating with a closed line
- Operation with rapid and frequent changes in flow requirements
- Operation over long periods with zero water flow

# Coolant requirements

## General thermal requirements

The following table lists the coolant requirements that the facility must meet in order to support an MCS-200/100 installation. In addition to the requirements listed, the coolant must meet the requirements prescribed in the "Acceptable water quality specifications (on page 78)" section.

| **Parameter** | **Value** |
|---|---|
| Maximum heat load operational chilled water temperature [1]<br>Minimum<br>Maximum | <br>7°C (45°F) minimum<br>13°C (55°F) maximum |
| Chilled water flow rate (maximum) [1]<br>MCS-100<br>MCS-200 | <br>Approximately 80 lpm(21 gpm)<br>Approximately 159 lpm (42 gpm) |
| Inlet/outlet water connections to MCS-200/100 2 (2) [2] | 1.75-inch BSPP (parallel-thread) |
| Inlet/outlet hose connections to facility | 1.25-inch BSPP (parallel-thread) |
| Hose insulation thickness | 6.3 mm (0.25 inch), min. closed cell |
| Condensate discharge tubing | 3 m (118 inch) length,<br>8 mm (0.31 inch) outer diameter,<br>6 mm (0.24 inch) inner diameter |
| Overflow tubing | 3 m (118 inches) length,<br>15 mm (0.59 inch) outer diameter,<br>9 mm (0.35 inch) inner diameter |
| Chilled water pressure differential at required flow | 1 - 1.5 bar (15 – 22 psi) required [1] |
| Cooling capacity [1]<br>MCS-100<br>MCS-200 | <br>30 kW maximum<br>50 kW maximum<br>(Performance is affected by water temperature) |

[1] For more information, see "Determining heat load capacities (on page 72)."

[2] For more information, see "Plumbing considerations (on page 46)."

Perform the following steps to confirm that the coolant requirements and corresponding resources necessary for effective implementation of the MCS-200/100:

1. Determine the maximum server heat load capacity.
2. Determine the desired server intake temperature. For more information, see the Rack Cooling Sizing Chart in "Cooling loop sizing (on page 72)."
3. Consult the building cooling system administration, and obtain the maximum coolant temperature, for example, 12.5°C.
4. Find the amount of coolant required. For more information, see "Coolant source planning (on page 45)."

# Cooling loop sizing

Sizing the cooling loops can be straight forward based on the planned cooling requirements of each populated/planned MCS-200/100 server enclosure. The amount of heat, in watts, that needs to be removed from each component in the server rack must be added together to obtain the total heat to be removed by the MCS-200/100 cabinet. You can copy the following table for documenting individual cabinet calculations. Calculations must include the equipment installed today and additional equipment planned for installation over the design life of the system.

**Rack Cooling Loop Sizing Chart**

| Installed Component | Quantity | Max. Watts Generated | Max. CFM Required | Max. Watts Total | Max. CFM Total |
|---|---|---|---|---|---|
| Component 1: | | | | | |
| Component 2: | | | | | |
| Component 3: | | | | | |
| Component 4: | | | | | |
| Component 5: | | | | | |
| Component 6: | | | | | |
| Component 7: | | | | | |
| Component 8: | | | | | |
| Component 9: | | | | | |
| Component 10: | | | | | |
| Total for Cabinet* | | | | | |

*An approximate value can be estimated by assuming all power entering the cabinet is converted to heat.

After calculating the total expected required heat load, use the charts in "Determining heat load capacities (on page 72)" to determine required water flow and pressure based on potential chilled water temperatures. The PSID must be measured prior to the cold water inlet/after warm water outlet. All water system equipment, materials, and installation must comply with any applicable construction codes and LAHJ.

# Determining heat load capacities

The total airflow required by the equipment installed in each server rack must be compared with the total available supply from the MCS-200/100, so it is not exceeded. The fans in the MCS-200/100 are speed-controlled to reduce the airflow in case the maximum cooling capacity is not demanded from the MCS-200/100.

**MCS per rack capacity chart**

| Number of fans | HP Modular Cooling System 200/100 | HP Modular Cooling System 200/100 with Expansion Rack | MCS-200/100 | MCS-200/100 with Expansion Rack |
|---|---|---|---|---|
| 1 fan (BW978A) | 10kW, 934 CFM | 5kW, 467 CFM | N/A | N/A |
| 2 fans | 20kW, 1,866 CFM | 10kW, 933 CFM | N/A | N/A |
| 3 fans | 30kW, 2,800 CFM | 15kW, 1,400 CFM | N/A | N/A |

| Number of fans | HP Modular Cooling System 200/100 | HP Modular Cooling System 200/100 with Expansion Rack | MCS-200/100 | MCS-200/100 with Expansion Rack |
|---|---|---|---|---|
| 4 fans | 30kW, 2,800 CFM N+1 Redundancy | 15kW, 1,400 CFM N+1 Redundancy | 30kW, 3,000 CFM | 15kW, 1,600 CFM |
| 5 fans | N/A | N/A | 40kW, 3, 750 CFM or 30kW N+1 | 20kW, 2,000 CFM or 15kW N+1 |
| 6 fans | N/A | N/A | 50kW, 4,500 CFM or 40kW N+1, 30kW N+2 | 30kW, 2,400 CFM or 20kW N+1, or 15kW N+2 |

Cooling performance is rated at 43 °F EWT. MCS with Expansion Rack capacity/airflow is pooled and does not have to be evenly split between racks. For example, the HP Modular Cooling System 200/100 with 3 fans, provides at total of 2,800 CFM. One rack can use 2,000 CFM and the other can use 800 CFM.

A minimum heat load is necessary for operating the MCS-200/100 properly. This minimum depends on the water supply temperature as shown in the following table.

**MCS-200 minimum heat loads**

| Server air intake temperature | Water supply temperature | Minimum heat load |
|---|---|---|
| 20°C (68°F) | 7°C (45°F) | 9 kW |
| | 10°C (50°F) | 7 kW |
| | 13°C (55°F) | 6 kW |
| | 16°C (61°F) | 6 kW |
| 25°C (77°F) | 7–13°C (45–55°F) | 16 kW |
| | 16°C (61°F) | 14 kW |
| | 18°C (64°F) | 10 kW |

**MCS-100 minimum heat loads**

| Server air intake temperature | Water supply temperature | Minimum heat load |
|---|---|---|
| 20 C (68 F) | 7°C (45°F) | 13 kW |
| | 11°C (52°F) | 7.5 kW |
| | 15°C (59°F) | 5 kW |
| | 19°C (66°F) | 3 kW |
| 25 C (77 F) | 11°C (52°F) | 13 kW |
| | 15°C (59°F) | 12 kW |
| | 11°C (66°F) | 6 kW |
| | 23°C (73°F) | 3 kW |
| 30 C (86 F) | 17°C (63°F) | 15 kW |
| | 21°C (70°F) | 13 kW |
| | 25°C (77°F) | 6 kW |
| | 29°C (84°F) | 3 kW |

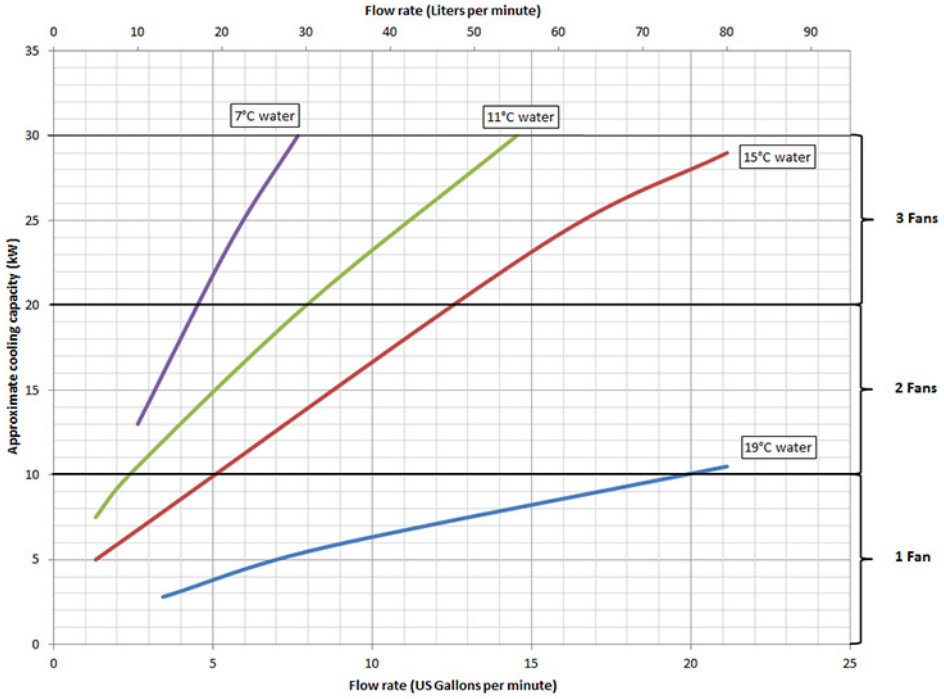
When the minimum heat load is not provided to the MCS-200/100, unstable control of the temperatures and flow rates of the MCS-200/100 can occur.

For more information, contact your HP representative.

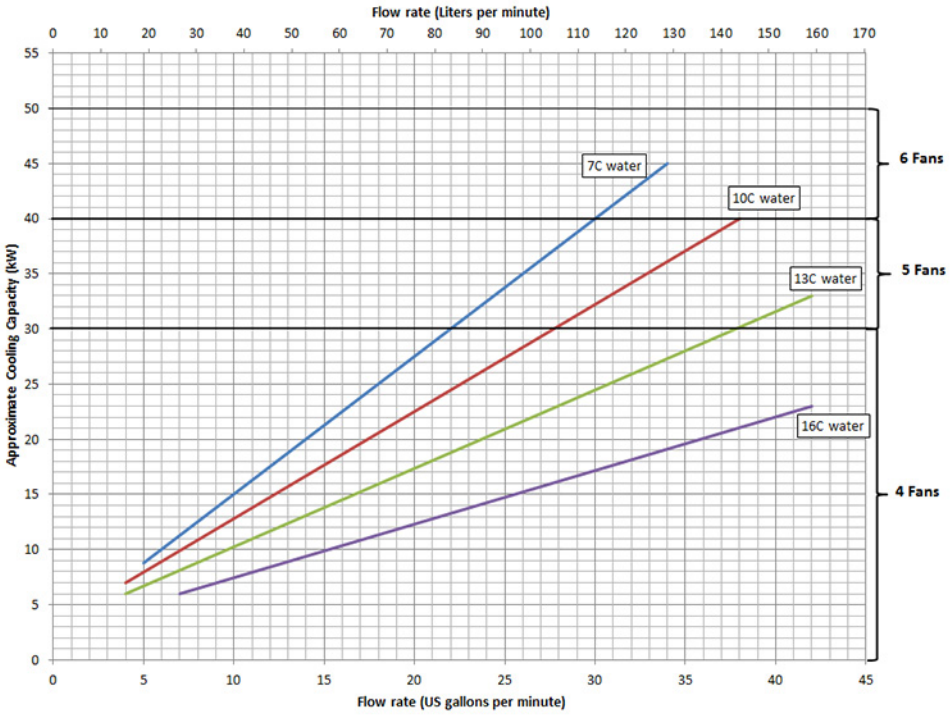
The following charts offer a guideline for determining the approximate amount of heat that can be removed from MCS-200/100 based on 20°C (68°F) and 25°C (77°F) server intake air temperatures (in degrees, Celsius), flow rates as liters per minute (lpm), or in US gallons per minute (gpm), delivered to the unit.

The term "water" in the following charts refers to the coolant described in "Acceptable water quality specifications (on page 78)."

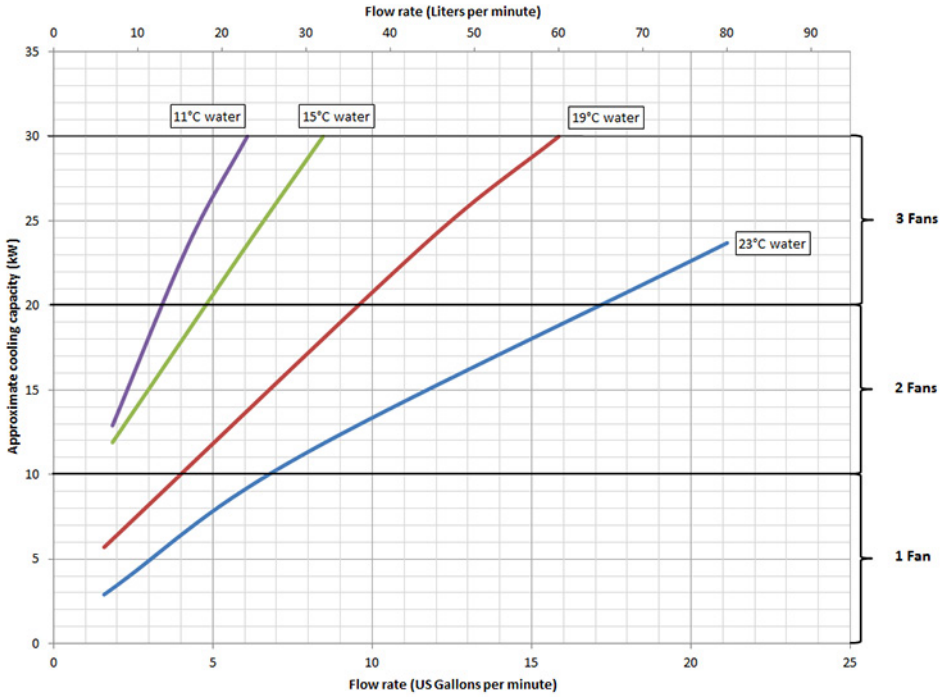
MCS-100 coolant flow requirements with 20°C (68°F) server intake air



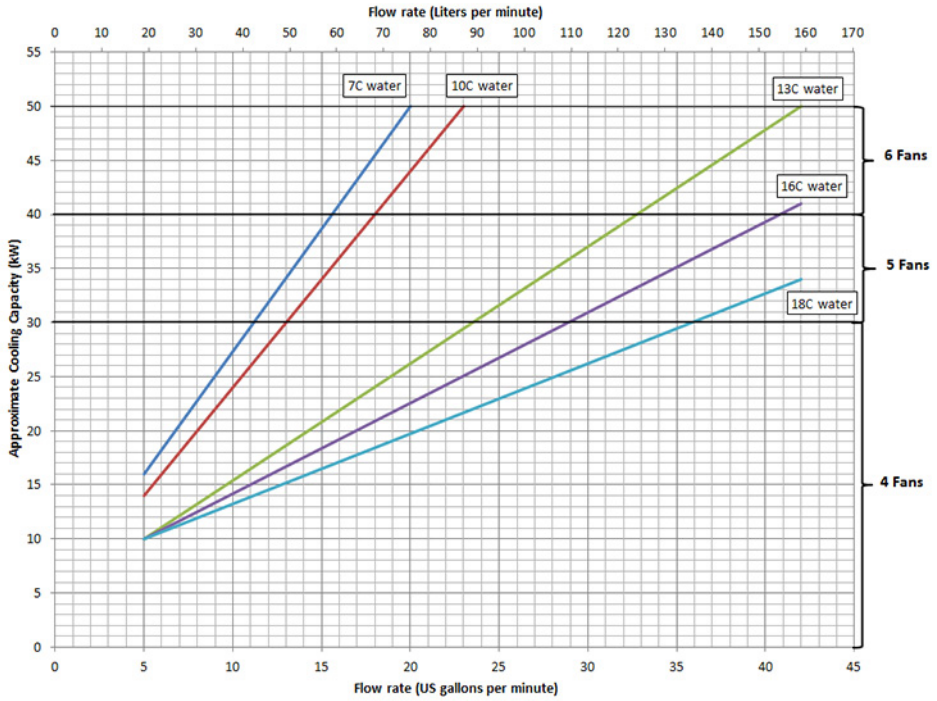
MCS-200 coolant flow requirements with 20°C (68°F) server intake air



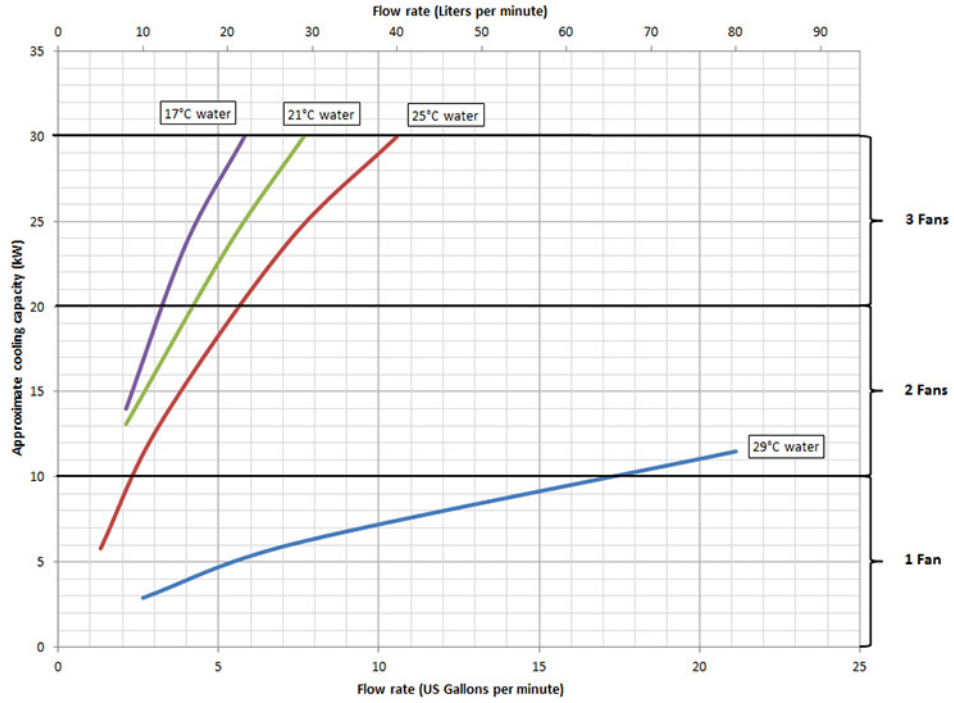

MCS-100 coolant flow requirements with 25°C (77°F) server intake air



MCS-200 coolant flow requirements with 25°C (77°F) server intake air

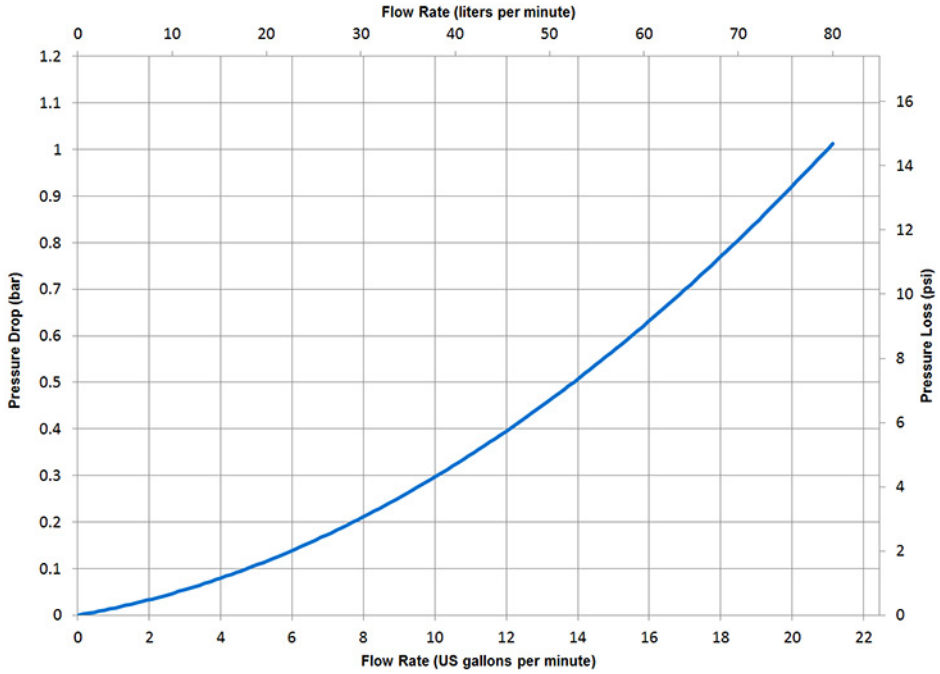



MCS-100 coolant flow requirements with 30°C (86°F) server intake air

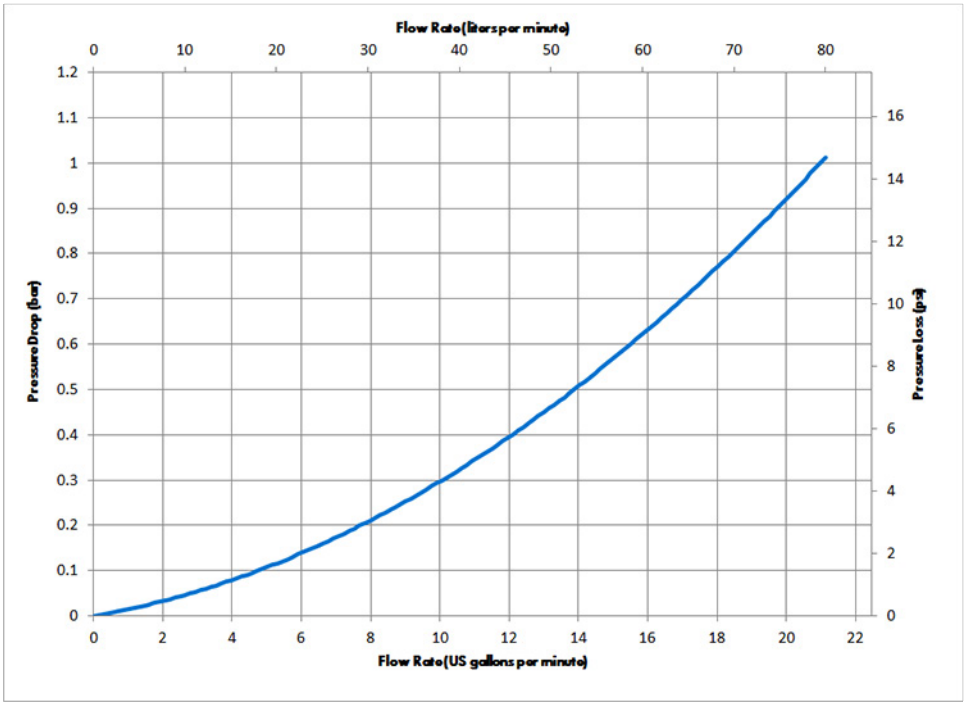



The following pressure-drop chart is provided as a reference to indicate water flow versus water pressure, for a fully-opened MCS-200/100 water control valve.

Flow rate versus delta pressure (water control valve fully open)—MCS-100




Flow rate versus delta pressure (water control valve fully open)—MCS-200




A minimum water pressure difference of 1.0 to 1.5 bar (15 to 20 psi) between facility supply and return is required. The previous figures give the pressure difference with a fully opened control valve. In operation, the control valve maintains the water flow to the MCS-200/100 by introducing pressure resistance to reduce the flow to accommodate different water temperatures and cooling capacity. Therefore, the pressure loss in operation appears higher than shown in the above figures. However, to have the full scale of water flow

available, the provided system pressure difference must be slightly higher than the maximum pressure loss with a fully opened control valve.

# Acceptable water quality specifications

Closed-loop water must not contain any lime scale deposits or loose debris. The water must have a low level of hardness, particularly a low level of carbon hardness. Filters must be used to remove free floating particulates and regularly maintained. The water must not be so soft that it corrodes the materials that it comes into contact. You must periodically add new fresh water, and remove some of the enriched water. HP recommends a #30 mesh filter for filtering water fed to the MCS-200/100 and a 1 µm filter for prolonged performance.

The following values are water quality ranges required for continuous quality of performance.

| **Parameter** | **Range** |
|---|---|
| pH | 7-9 |
| Specific conductance at 25°C (77°F) | <2500 µmhos |
| Sulfur ($SO_4$), total | <100 ppm |
| Chloride (Cl) | <50 ppm |
| Sulfide (S) | <10 ppm |
| Hardness ($CaCO_3$), total | <200 ppm |
| Iron (Fe), total | <3.0 ppm |
| Manganese (Mn), total | <0.1 ppm |
| Bacteria | <1000 CFUs/ml |
| Residue on evaporation | <500 ppm |
| Turbidity | 20 |
| Corrosion inhibitor | Recommended |

△ **CAUTION:** Contaminated water might cause decreased cooling capacity or disruption in service. The water flowing into the MCS-200/100 unit must meet the guidelines stated in the *HP Modular Cooling System 200/100 Site Preparation Guide*. Damage caused by contaminated water is not covered by the MCS unit warranty.

If your water is out of range, consult a water quality expert.

HP recommends using particulate filtration on the dedicated water supply system connected to the MCS-200/100 unit.

# Additional water precautions

The following actions should be taken during the installation of the MCS-200/100:

- Be sure all foreign matter and particulates are flushed from the system prior to installing the water kits for the MCS-200/100.
- Evaluate the short- and long-term system requirements against available water capacity.
- Be sure your facility water loop is properly designed for liquid cooling systems and separate from the sanitary water systems within your building—for example, bathroom, sink, or drinking water.

- Be sure facility managers understand that additional load is being added to the facility water supply. Be aware that the heat load being added might have an effect on other components being cooled by the facility water plant.

**CAUTION:** The water supply system feeding the MCS-200/100 must be capable of withstanding deadheading (operating with a closed line) and operation with rapid and frequent changes in flow requirements, including long periods with zero water flow.

## Plumbing materials to avoid

Do not use the following materials with a closed water system:

- Oxidizing biocides
- High zinc and brass components
- Non-stainless steel iron components

# Environmental considerations

| Parameter | Value |
|---|---|
| Room temperature<br>Recommended<br>minimum/maximum<br>Allowable minimum/maximum | <br>18°C(64.4°F)/27°C(80.6°F)<br>15°C (59°F)/32°C(90°F) |
| Humidity:<br>Recommended minimum<br>Recommended maximum<br>Allowable range | <br>5.5°C (41.9°F) dew point<br>60% relative humidity and 15°C (59°F) dew point<br>20%–80% |

The temperatures stated are for an elevation of 0 to 5000 ft above sea level. The maximum operating temperatures must be de-rated by 1°C per 1000 ft for locations 5000 to 10,000 ft above sea level.

# Control system

The MCS-200/100 includes a control system that constantly monitors the air temperatures, water temperatures, and flow rate. The management module attempts to maintain the air temperature at the target set point. If the set point temperature cannot be maintained, the HP Modular Cooling System 200/100 management module will generate an alarm and notify facility management systems, as configured.

For site evaluations and technical consulting services for your site, see the *HP Modular Cooling System 200/100 User Guide*.

## Before installing and running active components

**CAUTION:** If the MCS-200/100 unit runs in manual mode for a period of time without an adequate heat load being generated by servers or other computing/networking devices, excess condensation could occur within the cabinet or system.

Prior to starting up any active components mounted in the MCS-200/100 rack, such as servers, storage devices, and so on, the following actions must be performed:

- Be sure the chilled water source is on and flowing prior to the start-up of an MCS-200/100.
- Be sure the MCS-200/100 is operational and running before turning on the servers and closing the front and rear cabinet doors.

For more information on the installation of the HP Modular Cooling System 200/100, see the *HP Modular Cooling System 200/100 Installation Guide*.

# Appendix A: Forms and checklists

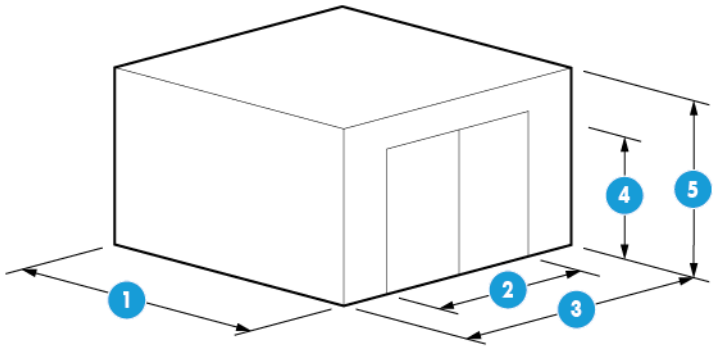
## Delivery survey form

⚠ **WARNING:** To prevent possible serious personal injury or damage to equipment, do not move the HP Modular Cooling System 200/100 up or down stairs.

The delivery survey form lists delivery or installation requirements. If any of the items on the list apply, enter the appropriate information in the areas provided on the form. Special instructions or recommendations should be entered on a special instructions or recommendations form. The following list gives examples of special instructions or issues:

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

Complete the following information if an elevator is required to move equipment:




| Item | Dimension | Measurement |
|---|---|---|
| 1 | Interior depth | |
| 2 | Door width | |
| 3 | Interior width | |
| 4 | Door height | |
| 5 | Interior height | |
| 6 | Elevator weight capacity | |

# Pre-installation checklists

## Site preparation checklist

The tables below are site preparation checklists. For each item, check "yes" or "no" in the appropriate column.

If the answer is no, then include a comment or explanation and the date. An alternative solution might be required

### Facility considerations

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 1 | Is there adequate clearance from the loading area to the installation site to accommodate rack dimensions, including the pallet, if applicable? | | | |
| 2 | Is there a completed floor plan, including a detailed location of the HP Modular Cooling System 200/100 relative to the floor tile breaks and supports? | | | |
| 3 | Is there adequate space for maintenance needs? Recommended clearances are minimum 1,219 mm (48 inches) in front, minimum 914 mm (36 inches) in the rear. | | | |
| 4 | Is access to the site or computer room restricted? | | | |
| 5 | Is the computer room structurally complete? What is the expected date of completion? | | | |
| 6 | Is a raised floor installed and in good condition? | | | |
| 7 | Is a raised floor system, including needed cutouts, able to adequately support the fully loaded rack and MCS-200? | | | |
| 8 | Are there channels or cutouts for cable routing? | | | |
| 9 | Is there a network line available? | | | |
| 10 | Are floor tiles in good condition and properly braced? | | | |
| 11 | Is there a leak detector for the facility water system (external to the MCS-200)? | | | |
| 12 | Are masonite boards available for floor protection during rack movement over carpets and thresholds? | | | |

### Power and lighting considerations

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 1 | Are there AC outlets available for servicing needs (for example, for laptop)? | | | |
| 2 | Does the input voltage correspond to MCS-100 and MCS-200/100 specifications? | | | |
| 3 | Is dual source power used? If so, identify types and evaluate grounding. | | | |
| 4 | Does the input frequency correspond to equipment specifications? | | | |
| 5 | Is power conditioning equipment installed? | | | |

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 6 | Is there a dedicated branch circuit for equipment? | | | |
| 7 | Is there a dedicated branch circuit less than 22.86 m (75 ft) away? | | | |
| 8 | Are the input circuit breakers sized to protect their respective receptacles for equipment loads? | | | |

## Safety considerations

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 1 | Is there an emergency power shutoff switch? | | | |
| 2 | Is there a telephone available for emergency purposes? | | | |
| 3 | Is there a fire protection system in the computer room? | | | |
| 4 | Is antistatic flooring installed? | | | |

## Cooling considerations

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 1 | Can the room temperature be maintained between the recommended range of 20°C to 25°C (68°F to 77°F) and allowable range of 15°C to 32°C (59°F to 90°F) (up to 5,000 ft)? Derate 1°C/1,000 ft above 5,000 ft and up to 10,000 ft. | | | |
| 2 | Can the humidity level be maintained at the recommended level of 40% to 50%, with allowable humidity levels of 20% to 60%? | | | |
| 3 | Are air conditioning filters installed and clean? | | | |

## Water preparation considerations

| Item | Area/condition | Yes | No | Comment/date |
|---|---|---|---|---|
| 1 | Has the water been tested for acceptable quality for use in the HP Modular Cooling System 200/100? | | | |
| 2 | If the water quality is unacceptable, have adequate treatment filtration measures been put in place? | | | |
| 3 | Have the water temperature and flow been evaluated? | | | |
| 4 | Has piping of an appropriate diameter, material, and pressure tolerance been installed to reach the back of each MCS-100 and MCS-200/100? | | | |
| 5 | Is there a provision for fluid collected from the condensation and overflow hoses at each MCS-100 and MCS-200/100? | | | |
| 6 | Is there dedicated cabinet space for storage of water quality chemicals and gloves? | | | |
| 7 | Is there an available space to prepare and handle chemicals before adding them to the system? | | | |
| 8 | Is Nalprep 8349 (commercially available from Nalco Company) available on site for the secondary loop cleaning procedure? | | | |
| 9 | Has the approximate volume of water in the entire system been determined? (Necessary for water chemical preparation) | | | |
| 10 | Have the water treatment chemicals been evaluated and approved through your facility EHS department? | | | |

# Appendix B: Conversion factors and formulas

## Conversion factors and formulas

The conversion factors provided in this appendix are intended to ease data calculation for systems that do not provide information in the format requested in this site preparation guide. The following list includes the conversion factors used in this document, as well as additional conversion factors that might be helpful in determining those factors required for site planning.

### Conversion factors for refrigeration

- 1 watt = 0.86 kcal/hour
- 1 watt = 3.412 British thermal unit (BTU)/hour
- 1 ton = 200 BTU/minute
- 1 ton = 12,000 BTU/hour
- 1 ton = 3,517.2 W

### Metric equivalents

- 1 centimeter = 0.3937 inches
- 1 meter = 3.28 feet
- 1 meter = 1.09 yards
- 1 inch = 2.54 centimeters
- 1 foot = 0.305 meters
- 1 cubic foot/minute = 1.7 cubic meters/hour

### kVa conversions

- Three-phase kilovolt-amperes (kVA) = V x A x √3/1,000
- Single-phase kVA = V x A/1,000

### Formulas

- kVA = [Voltage x Current (amps)]/1,000
- Watts = VA x power factor
- BTU = Watts x 3.41

# Regulatory information

## Safety and regulatory compliance

For safety, environmental, and regulatory information, see *Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products*, available at the HP website (http://www.hp.com/support/Safety-Compliance-EnterpriseProducts).

## Turkey RoHS material content declaration

Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

## Ukraine RoHS material content declaration

Обладнання відповідає вимогам Технічного регламенту щодо обмеження використання деяких небезпечних речовин в електричному та електронному обладнанні, затвердженого постановою Кабінету Міністрів України від 3 грудня 2008 № 1057

## Warranty information

HP ProLiant and X86 Servers and Options (http://www.hp.com/support/ProLiantServers-Warranties)

HP Enterprise Servers (http://www.hp.com/support/EnterpriseServers-Warranties)

HP Storage Products (http://www.hp.com/support/Storage-Warranties)

HP Networking Products (http://www.hp.com/support/Networking-Warranties)

## Regulatory requirements for EXIT signs

Manufacturers of tritium EXIT signs are “specific licensees,” meaning they are licensed by the NRC or an Agreement State. The signs are considered “generally licensed devices,” because they are inherently safe enough to be handled or used by anyone with no radiation training or experience. Although purchasers – known as “general licensees” – do not need authorization from the NRC or a state regulatory agency to possess the signs, they are subject to certain regulatory requirements regarding handling, transfer or disposal of the signs. For more information, see the NRC website (http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-tritium.html#_edn2). They are also subject to NRC or Agreement State inspection and enforcement action (including fines) for violating those requirements. Manufacturers must inform purchasers of the EXIT signs of the regulatory requirements for generally licensed devices. The general licensee is required to designate an individual responsible for complying with the regulatory requirements.

Under NRC regulations, a general licensee using tritium EXIT signs:

- must NOT remove the labeling or radioactive symbol, or abandon a sign;
- must properly dispose of an unused sign (see below);
- must report to the NRC or the appropriate Agreement State any lost, stolen or broken signs;
- must inform the NRC or an Agreement State of a name change, change of address or replacement of a general licensee's designated representative;
- must NOT give away or sell the sign to another individual, company or institution unless the device is to remain in use at its original intended location; in such a case, the transferor is to notify the recipient of the regulatory requirements and must notify the NRC or Agreement State of the transfer within 30 days.

Tritium EXIT signs must NOT be disposed of as normal trash. To dispose of a sign properly, a general licensee must transfer the sign to a specific licensee. This would typically be a manufacturer, distributor, licensed radioactive waste broker, or a licensed low-level radioactive waste disposal facility. These facilities may charge a fee for this service.

Within 30 days of disposing of a sign, the general licensee is required to file a report to the NRC or Agreement State that includes:

- the device manufacturer's (or distributor's) name, model number and serial number;
- the name, address, and license number of the person receiving the device; and
- the date of the transfer.

Reports should be sent to Director, Office of Federal and State Materials and Environmental Management Programs, ATTN: GLTS, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001.

For more information, see the Fact Sheet on Tritium EXIT Signs on the NRC website (http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-tritium.html).

# Support and other resources

## Before you contact HP

Be sure to have the following information available before you call HP:

- Active Health System log (HP ProLiant Gen8 or later products)

  Download and have available an Active Health System log for 3 days before the failure was detected. For more information, see the *HP iLO 4 User Guide* or *HP Intelligent Provisioning User Guide* on the HP website (http://www.hp.com/go/ilo/docs).
- Onboard Administrator SHOW ALL report (for HP BladeSystem products only)

  For more information on obtaining the Onboard Administrator SHOW ALL report, see the HP website (http://www.hp.com/go/OAlog).
- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Product identification number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

## HP contact information

For United States and worldwide contact information, see the Contact HP website (http://www.hp.com/go/assistance).

In the United States:

- To contact HP by phone, call 1-800-334-5144. For continuous quality improvement, calls may be recorded or monitored.
- If you have purchased a Care Pack (service upgrade), see the Support & Drivers website (http://www8.hp.com/us/en/support-drivers.html). If the problem cannot be resolved at the website, call 1-800-633-3600. For more information about Care Packs, see the HP website (http://pro-aq-sama.houston.hp.com/services/cache/10950-0-0-225-121.html).

# Acronyms and abbreviations

### BSPP

british standard pipe parallel

### CHWR

chilled water return

### CHWS

chilled water supply

### CTO

configure to order

### FRU

field replaceable unit

### GRUB

gas, oil, water

### HEX

heat exchanger

### LAHJ

local authority has jurisdiction

### NPT

national pipe thread

### NPTF

American national taper pipe thread for dry-seal pressure-tight joints

### PF

polytetrafluoroethylene

### TN Grounding

grounding specification

## UPS

uninterruptible power system

## WSP

water steam pressure

# Documentation feedback

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