Preparing the Site

Temperature Requirements

The switch requires an operating temperature of 32 to 104 degrees Fahrenheit (0 to 40 degrees Celsius). If the switch is not operating, the temperature must be between –40 to 158 degrees Fahrenheit (–40 to 70 degrees Celsius).

Humidity Requirements

Buildings in which the climate is controlled by air-conditioning in the warmer months and by heat during the colder months usually maintain an acceptable level of humidity for the switch equipment. However, if the switch is located in an unusually humid location, use a dehumidifier to maintain the humidity within an acceptable range.

Altitude Requirements

This switch is rated to operate at altitudes from 0 to 10,000 feet (0 to 3,048 meters). If you operate this switch at a higher altitude (low pressure), the efficiency of forced and convection cooling is reduced and can result in electrical problems that are related to arcing and corona effects. This condition can also cause sealed components with internal pressure, such as electrolytic capacitors, to fail or to perform at a reduced efficiency.

Dust and Particulate Requirements

Exhaust fans cool power supplies and system fans cool switches by drawing in air and exhausting air out through various openings in the chassis. However, fans also ingest dust and other particles, causing contaminant buildup in the switch and increased internal chassis temperature. Dust and particles can act as insulators and interfere with the mechanical components in the switch. A clean operating environment can greatly reduce the negative effects of dust and other particles.

In addition to regular cleaning, follow these precautions to avoid contamination of your switch:

- Do not permit smoking near the switch.
- Do not permit food or drink near the switch.

Minimizing Electromagnetic and Radio Frequency Interference

Electromagnetic interference (EMI) and radio frequency interference (RFI) from the switch can adversely affect other devices, such as radio and television (TV) receivers. Radio frequencies that emanate from the switch can also interfere with cordless and low-power telephones. Conversely, RFI from high-power telephones can cause spurious characters to appear on the switch monitor.

RFI is defined as any EMI with a frequency above 10 kHz. This type of interference can travel from the switch to other devices through the power cable and power source or through the air as transmitted radio waves. The Federal Communications Commission (FCC) publishes specific regulations to limit the amount of EMI and RFI that are emitted by computing equipment. Each switch meets these FCC regulations.

To reduce the possibility of EMI and RFI, follow these guidelines:

- Cover all open expansion slots with a blank filler plate.
- Always use shielded cables with metal connector shells for attaching peripherals to the switch.

When wires are run for any significant distance in an electromagnetic field, interference can occur to the signals on the wires with the following implications:

- Bad wiring can result in radio interference emanating from the plant wiring.
- Strong EMI, especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the chassis and even create an electrical hazard by conducting power surges through lines into equipment.

Note To predict and prevent strong EMI, you need to consult experts in radio frequency interference (RFI).

The wiring is unlikely to emit radio interference if you use a twisted-pair cable with a good distribution of grounding conductors. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

Caution If the wires exceed the recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse that is caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic switches. You will want to consult experts in electrical surge suppression and shielding if you had similar problems in the past.

Shock and Vibration Requirements

The switch has been shock- and vibration-tested for operating ranges, handling, and earthquake standards.

Grounding Requirements

The switch is sensitive to variations in voltage that is supplied by the power sources. Overvoltage, undervoltage, and transients (or spikes) can erase data from memory or cause components to fail. To protect against these types of problems, ensure that there is an earth-ground connection for the switch. You can connect the grounding pad on the switch either directly to the earth-ground connection or to a fully bonded and grounded rack.

When you properly install the chassis in a grounded rack, the switch is grounded because it has a metal-to-metal connection to the rack. Alternatively, you can ground the chassis by using a customer-supplied grounding cable that meets your local and national installation requirements. For U.S. installations, we recommend 6-AWG wire. Connect your grounding cable to the chassis with a grounding lug (provided in the switch accessory kit) and to the facility ground.

Note You automatically ground AC power supplies when you connect them to AC power sources. For DC power supplies, you must connect a grounding wire when wiring the power supply to the DC power source.

Planning for Power Requirements

To plan for the power requirements of a switch, you must determine each of the following:

- Power requirements for all the switch components
- Minimum number of power supplies required to power the components that are installed in the switch.
- Power mode to use and the number of extra power supplies required for that mode.

Ensure that the circuit that is used for the switch is dedicated to the switch to minimize the possibility of circuit failure. Also, ensure that the switch uses either AC or DC power sources, not a mix of AC and DC power sources.

Calculate the power that is required for operations (available power) and redundancy (reserve power), then you can plan for the required number of input power receptacles. The power receptacles will be within reach of the switch location.

Step 1 Determine the power requirement for the modules in the switch by summing the maximum wattage for each installed module, see the following table.

Component		Typical	Maximum
Supervisor modules		—	—
–	Supervisor A (N9K-SUP-A)	69 W	80 W
–	Supervisor A+ (N9K-SUP-A+)	69 W	80 W
–	Supervisor B (N9K-SUP-B)	75 W	90 W
–	Supervisor B+ (N9K-SUP-B+)	75 W	80 W
System Controller Modules		—	—
–	System Controller (N9K-SC-A)	14 W	25 W
Line cards that are supported by N9K-C9508-FM fabric modules		176 W	251 W
–	36-port 40-Gigabit Ethernet QSFP+ line cards (N9K-X9736PX)	197 W	211 W
Line cards that are supported by N9K-C9508-FM-E and N9K-C9508-FM-E2 fabric modules		455 W 266 W	570 W 420 W
– – –	32-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9732C-EX) 36-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9736C-FX) 36-port 40-Gigabit Ethernet QSFP28 line card (N9K-X9736Q-FX)	430 W 607 W 571 W	720 W 720 W 684 W
Fan Trays (N9K-C9508-FAN)		176 W	250 W

For example, to determine the maximum amount of power that your fully loaded switch consumes, add the maximum power consumption of two supervisor A modules (2 x 80 W = 160 W), two system controllers (2 x 25 W = 50 W), eight 36-port 40-Gigabit line cards (8 x 211 W = 1688 W), six fabric modules (6 x 251 W = 1506 W), and three fan trays (3 x 250 W = 750 W). The total is 4154 W.

Step 2 Determine the number of power supplies required to power the modules that are installed in the switch by dividing the module power requirement amount (see Step 1) by the output wattage (3000 W) of the power supplies installed in the switch. Round up the fractional result to the nearest ones digit.

For example, if you are installing a switch with maximum consumption of 4154 W, you need two power supplies (4154 W / 3000 W = 1.38 [rounded up to two power supplies]) to operate the switch and its modules.

Step 3 Determine the amount of power that is required from a power source.

The power supplies are rated to have at least 91-percent efficiency.

- To determine the input power (Watts) from the power source to the power supplies, divide the output power of each power supply (3000 W) by the efficiency of the power supply (0.91) and then multiply the result by the number of power supplies required to power the switch. For example, if the switch uses 2 power supplies, you can calculate the amount of power that is required from the power source as follows:

3000 W output / 0.91 efficiency X 2 power supplies = 6593 W

- To determine the number of Amps (A) that are required to power the switch, divide the maximum Watts that is required for by the voltage that is used as shown in the following examples:
  - For 6593 A at 200-volts AC (VAC), use the following formula:

    (6593 W)/(200 VAC) = 33 A
  - For 6593 A at 277-volts AC (VAC), use the following formula:

    (6593 W)/(277 VAC) = 23.8 A
  - For 6593 A at 380-volts DC (VDC), use the following formula:

    (6593 W)/(380 VDC) = 17.4 A
- To determine the required BTUs, multiply the Watts that is required for the power source by 3.41214163.

  For example, for 6593 W, use the following formula:

  (6593 W) X (3.41214163 BTU) = 22,496

To size the circuit breaker for the required amperage, you must also divide the required amperage by the percentage. For example, if the switch requires an input amperage of 33 A and you are able to use up to 80 percent of the capacity of a circuit breaker, you use the following formula to calculate the minimum amperage that is required of the circuit breaker:

(33 A)/ (80% or 0.80) = 41.25 amps

Step 4 Select one of the following power modes to determine the number of additional power supplies required for reserve power:

- Combined power—Do not add any power supplies to the number of power supplies that are calculated for the available power in Step 2. This power mode does not provide power redundancy, so no extra power supplies are needed.
- *n*+1 redundancy—Add one power supply (reserve power supply) that can output as much power as the most powerful power supply that is used for active power. This form of power redundancy provides a reserve power supply that can replace any active power supply that goes offline.
- *n*+*n* redundancy—Add enough power supplies (reserve power supplies) to at least equal the total output of the active power supplies (the number of power supplies that are calculated in Step 2). Typically, you double the number of power supplies. Plan for a second power source for the reserve power supplies. For example, if you calculate that you need two 3-kW power supplies for 6 kW of available power, you need another two 3-kW power supplies for 6 kW of reserve power (for a total of four 3-kW power supplies used for available and reserve power).

Step 5 Be sure that the power source circuits are dedicated to the switch and not to other electrical equipment.

For combined mode or *n*+1 redundancy mode, you need only one dedicated circuit. For *n*+*n* redundancy, you must have two dedicated power circuits, with each circuit powering half of the 3-kW power supplies. The requirements for each circuit are listed in the following table.

Power Supply	Number of Circuits	Requirement for Each Circuit
3-kW AC power supply (N9K-PAC-3000W-B)	1 (combined mode or *n+1* redundancy mode) 2 (*n+n* redundancy mode)	16 A at 200 to 240 VAC
3-kW Universal AC/DC power supply (N9K-PUV-3000W-B and N9K-PUV2-3000W-B)	1 (combined mode or *n+1* redundancy mode) 2 (*n+n* redundancy mode)	AC power: 200 to 277 VAC DC power: 240 to 380 VDC
3-kW DC power supply (N9K-PDC-3000W-B)	1 (combined mode or *n+1* redundancy mode) 2 (*n+n* redundancy mode)	45A at -40 to -75 VDC (-48 VDC nominal US) (-60 VDC nominal international)

Step 6 Plan the placement of the input power receptacles within reach of the power cables that are used for each power supply, see the following table for the maximum distances.

Typically, power receptacles are placed on the rack with the switch.

Power Supply	Maximum Distance Between Receptacle and Power Supply
3-kW AC power supplies	8 to 12 feet (2.5 to 3.5 m)
3-kW Universal AC/DC power supplies	14 feet (4.27 m)
3-kW DC power supplies	You provide four 6-gauge wires (recommended) and cuts that wire to the required length. We provide four 6-gauge lugs to connect those wires to the DC power supply.

Note The switch can be powered by a mix of AC, DC, HVAC/HVDC power sources.

Rack and Cabinet Requirements

You can install the following types of racks or cabinets for your switch:

- Standard perforated cabinets
- Solid-walled cabinets with a roof fan tray (bottom-to-top cooling)
- Standard open four-post Telco racks

To install the switch in a cabinet that is located in a hot-aisle and cold-aisle environment, fit the cabinet with baffles to prevent exhaust air from recirculating into the chassis air intake.

Work with your cabinet vendors to determine which of their cabinets meet the following requirements or see the Cisco Technical Assistance Center (TAC) for recommendations:

- Use a standard 19-inch (48.3-cm), four-post Electronic Industries Alliance (EIA) cabinet or rack with mounting rails that conform to English universal hole spacing per section 1 of the ANSI/EIA-310-D-1992 standard.
- The height of the rack or cabinet must accommodate the 13-RU (22.7 inches or 57.8 cm) height of the switch and its bottom support bracket.
- The depth of a four-post rack must be 24 to 32 inches (61.0 to 81.3 cm) between the front and rear mounting rails (for proper mounting of the bottom-support brackets or other mounting hardware).
- Required clearances between the chassis and the edges of its rack or the interior of its cabinet are as follows:
  - 4.5 inches (11.4 cm) between the front of the chassis and the front of the rack or interior of the cabinet (required for cabling and module handles).
  - 3.0 inches (7.6 cm) between the rear of the chassis and the interior of the cabinet (required for airflow in the cabinet if used).
  - No clearance is required between the chassis and the sides of the rack or cabinet (no side airflow).

Also, you must consider the following site requirements for the rack:

- Power receptacles must be located within reach of the power cords that are used with the switch.
  - Power cords for the 3-kW AC power supplies are 8 to 12 feet (2.5 to 4.3 m) long.
  - Power cords for the 3-kW Universal AC power supplies are 14 feet (4.27 m) long.

Note The power cables for the 3-kW DC power supply are provided by and sized you.

- Clearance is required for cables that connect to as many as 288 ports (in addition to the cabling required for other devices in the same rack). These cables must not block access to any removable chassis modules or block airflow into or out of the chassis. Route the cables through the cable management frames on the left and right sides of the chassis.

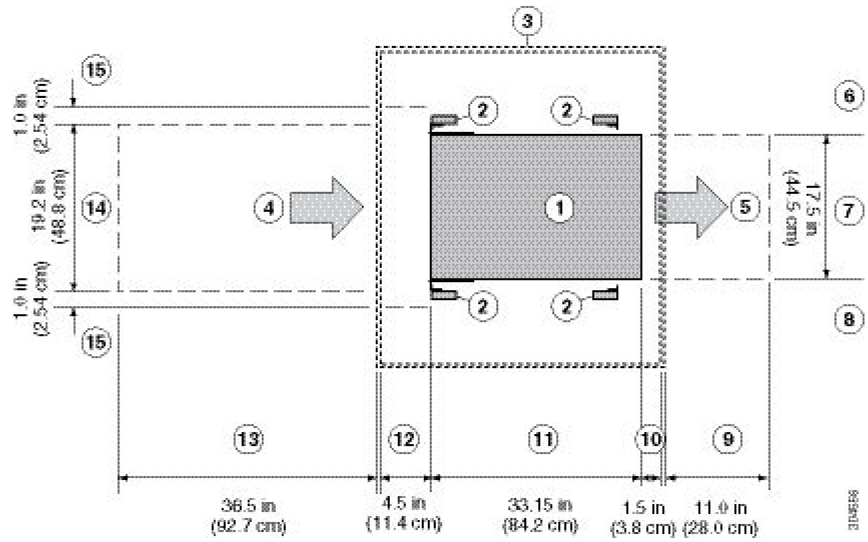
Also, you must have power receptacles that are located within reach of the power cords that are used with the switch.

Warning **Statement 1048—**Rack Stabilization

Stability hazard. The rack stabilizing mechanism must be in place, or the rack must be bolted to the floor before you slide the unit out for servicing. Failure to stabilize the rack can cause the rack to tip over.

Clearance Requirements

Provide the chassis with adequate clearance between the chassis and any other rack, device, or structure so that you can properly install the chassis. Provide the chassis with adequate clearance to route cables, provide airflow, and maintain the switch. For the clearances required for an installation of this chassis, see the following figure.



1	Chassis	9	Rear service clearance required to replace fan trays and fabric modules.
2	Vertical rack-mount posts and rails	10	Minimum clearance required for module handles (up to 6 inches [15.24 cm] recommended for optimal airflow) when using cabinet doors
3	Cabinet (optional)	11	Chassis depth
4	Air intake from the cold aisle for all modules and power supplies	12	Recommended clearance for cable management and ejector handles on line cards (6 inches [15.24 cm] recommended for optimal airflow) when using cabinet doors
5	Air exhaust to the hot aisle for all modules and power supplies	13	Clearance required for installing the chassis and replacing line cards
6	No left-side clearance required (no airflow on the left side).	14	Width of the chassis plus vertical mounting brackets on each side

7	Chassis width	15	Side clearance, that is required for older line card handle rotation (not required for the current line cards which have handles that rotate differently).
8	No right-side clearance required (no airflow on the right side).		