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ROOFTOP EQUIPMENT GUIDE – Code Requirements

GENERAL

The purpose of this guide is to clarify the minimum building code and inspection requirements for rooftop equipment installation, and assist in preparation for a final inspection.

The provided information is general and intended as a guide only. Each project is unique and additional requirements may be required by building code, and as deemed appropriate.

PERMIT SUBMITTAL REQUIREMENTS

Provide the following information on the plans to be submitted for review when replacing existing rooftop equipment with new equipment or installing new equipment on rooftops. Code requirements are based on the 2016 California Building and Mechanical Codes.

GENERAL – NON-APPROVED CONSTRUCTION

The following items are not approved:

1. Roof curbs shall not be installed over roofing.
2. All roof curbs supporting the equipment shall be roofed-in. (See *FIGURE A-3: EXAMPLE OF ROOFTOP INSTALLATION REQUIREMENTS* below).
3. Wood curbs are not approved in Types I and II Construction.
4. Single pass cooling water systems are prohibited: clean running water used exclusively as a cooling medium in an appliance, device, or apparatus is prohibited.
5. Copper, copper alloys, lead and lead alloys, including brass, shall not be used for building sanitary sewer systems, except for domestic waste sink traps and short lengths of associated connecting pipes where alternate materials are not practical.
 - a. Where permitted by the Building Official, copper tube for drainage and vent piping shall have a weight of not less than that of copper drainage tube type DWV.

SPECIFIC STRUCTURAL SUBMITTAL REQUIREMENTS

Roof Support

1. Roofs on which equipment is to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load. [CMC 303.9.1]

Anchorage of Appliances

1. Appliances that are designed to be fixed in position, shall be securely fastened in place. [CMC 303.5]
2. Supports for appliances shall be designed and constructed to sustain vertical and horizontal loads within the stress limitations specified in the Building Code. [CMC 303.5]

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Earthquake Loads

1. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7-10. [CBC 1604]

MINIMUM EQUIPMENT INSTALLATION SUBMITTAL REQUIREMENTS

Nonstructural Component Loads

1. Components and their supports shall be attached (or anchored) to the structure in accordance with the requirements of this section, and the attachment shall satisfy the requirements for the parent material as set forth elsewhere in this standard. [ASCE 7-10]
2. Component attachments shall be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
3. A continuous load path of sufficient strength and stiffness between the component and the supporting structure shall be provided.
4. Local elements of the structure including connections shall be designed and constructed for the component forces where they control the design of the elements or their connections.
5. Architectural, mechanical, and electrical components, supports, and attachments shall comply with the sections referenced in ASCE 7-10 Table 13.2-1. These requirements shall be satisfied by one of the following methods:
 - a. Project-specific design and documentation prepared and submitted by a registered design professional.
 - b. Submittal of the manufacturer's certification that the component is seismically qualified by:
 - i. Analysis.
 - ii. Testing in accordance with the alternative set forth in Section 13.2.5.
 - iii. Experience data in accordance with the alternative set forth in Section 13.2.6.

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Table 13.2-1
APPLICABLE REQUIREMENTS FOR ARCHITECTURAL,
MECHANICAL, AND ELECTRICAL COMPONENTS:
SUPPORTS AND ATTACHMENTS

Nonstructural Element (i.e., Component, Support, Attachment)	General Design Requirements Section 13.2	Force and Displacement Requirements Section 13.3	Attached Requirements Section 13.4	Architectural Component Requirements Section 13.5	Mechanical and Electrical Component Requirements Section 13.6
Architectural Components, and Supports and Attachments for Architectural Components	X	X	X	X	
Mechanical and Electrical Components with $I_p > 1$	X	X	X		X
Supports and Attachments for Mechanical and Electrical Components	X	X	X		X

MECHANICAL AND ELECTRICAL COMPONENTS

1. The attachment of mechanical and electrical components and their supports to the structure shall meet the requirements of structural installations. [ASCE 7-10 Section 13.6]
2. Materials comprising supports and the means of attachment to the component shall be constructed of materials suitable for the application, including the effects of service conditions, for example, low temperature applications. [ASCE 7-10 Section 13.6.5.4]
3. Materials shall be in conformance with a nationally recognized standard, except as follows:
 - a. Mechanical and electrical components in Seismic Design Categories **D**, **E**, and **F** where the component importance factor, I_p , is equal to 1.0 **and either**:
 - i. Flexible connections between the components and associated ductwork, piping, and conduit are provided.
 - ii. Components are mounted at 4 ft or less above a floor level (installations at roof levels must have design loads equal to floors for this to apply) and weigh 400 lbs or less.
 - b. Mechanical and electrical components in Seismic Design Categories **D**, **E**, and **F** where the component importance factor, I_p , is equal to 1.0 **and**
 - i. Flexible connections between the components and associated ductwork, piping, and conduit are provided.

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- ii. The components weigh 20 lbs or less or, for distribution systems, weighing 5 lb/ft or less. [ASCE 7-10 Section 13.1.4]
4. Curbs for equipment over 400 lbs shall be engineered with plans submitted for approval.
5. Curbs for equipment less than 400 lbs shall be constructed per **Figure A-1** below.
6. Approved plans for curb to frame connection are required.
7. Use of curb adaptors is prohibited. Size curbs to fit equipment.
8. A separate inspection of curb connection is required before unit is set.

ADDITIONAL MECHANICAL AND ELECTRICAL SUPPORT REQUIREMENTS

The following additional requirements shall apply to mechanical and electrical component supports:

1. **Seismic Supports** shall be constructed so that support engagement is maintained.
2. **Oversized Plate Washers** or other reinforcement shall be provided at bolted connections through a sheet metal base if the base is not reinforced with stiffeners or is not capable of transferring the required loads.
3. Attachments at cold-formed steel supports relied upon for the seismic load path shall be engineer designed and details provided.
4. Components mounted on vibration isolators **shall have** a bumper restraint or “snubber” in each horizontal direction and vertical restraints shall be provided where required to resist overturning.
 - a. Isolator housings and restraints shall be constructed of ductile materials. (See additional design force requirements in ASCE 7-10 footnote *b* to Table 13.6-1.)
 - b. A viscoelastic (exhibiting both viscous and elastic characteristics when undergoing deformation) pad or similar material of designed thickness shall be used between the bumper and components to limit the impact load.
5. Expansion anchors shall not be used for non-vibration isolated mechanical equipment rated over 10 hp. EXCEPTION: Undercut expansion anchors are permitted.
6. The supports for electrical distribution components shall be designed for the seismic forces and relative displacements if any of the following conditions apply:
 - a. lp is equal to 1.5 and conduit diameter is greater than 2.5 inches trade size.
 - b. Trapeze assemblies supporting conduit, and bus ducts or cable trays where lp is equal to 1.5 and the total weight of the bus duct, cable tray, or conduit supported by trapeze assemblies exceeds 10 lb/ft.
 - c. Supports are cantilevered up from the floor.
 - d. Supports include bracing to limit deflection.
 - e. Supports are constructed as rigid welded frames.
 - f. Attachments into concrete utilize nonexpanding insets, power actuated fasteners, or cast iron embedments.
 - g. Attachments utilize spot welds, plug welds, or minimum size welds as defined by AISC.

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For mechanical equipment, drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.

GENERAL INSPECTION REQUIREMENTS

The contractor has the responsibility to review the following inspection items and have them ready for inspection. Plans and manufacturer's installation instructions shall be made available to the inspector at time of inspection.

Gas Connector shall be rated/sized for the demand load of each appliance.

The connector shall not exceed 3'-0" in length and all existing/old connectors shall not be reused when replacing an appliance.

Do not remove the sizing label from the connectors as these must be reviewed as part of the inspection.

Remove Abandoned Equipment above ceiling and on rooftops.

Sight Screening: If applicable, verify that sight screening is per *planning regulations* and roof attachments are included in the scope of permitted work.

Energy Efficiency: Verify seasonal energy efficiency rating [2013 California Energy Code]

Roof Support: Roofs on which equipment is to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load. [CMC 303.9.1]

Corrosion Resistant: All roof top access locks, screws, and bolts shall be corrosion-resistant. [CMC 303.9.2]

Roof Drainage: Equipment shall be installed on well-drained surface of the roof.

Where water stands on roof at the equipment or passageways to the equipment, a suitable platform, walkway or both shall be provided above the waterline and shall be located adjacent to equipment and control panels so that the equipment can be safely serviced were water stands. [CMC 304.2.3]

Equipment Deck and Cap Flashing Drainage: All equipment sheet metal deck/caps/lids and cap flashing shall have a minimum ¼" per foot slope. FIX: Apply a two-part epoxy system roof coating or snow roof system.

Listed Appliances: Except as otherwise provided in the code, the installation of appliances regulated by this code shall conform to the conditions of listing. The appliance installer shall leave the manufacturer's installation and operating instructions attached to the appliance. Clearances of listed appliances from combustible materials shall be as specified in the listing or on the rating plate. [CMC 303.2]

Enclosures: Equipment on roof shall be designed or enclosed so as to withstand climatic conditions in the areas in which it is installed. Where enclosures are provided, each enclosure shall be of reasonable height, and shall have at least a thirty (30) inch clearance between the entire service access panel(s) of the equipment and the wall of the enclosure. [CMC 303.9]

Access: Appliances shall be accessible for inspection, service, repair and replacement without removing permanent construction. Not less than 30" depth, width and height of working space. [CMC 304.1]

Electrical Power: All equipment requiring an external source of electrical power for its operation shall be provided with:

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Readily accessible electrical disconnecting means within sight of the equipment. [CMC 303.9.4 (1)]

A 120VAC grounding-type receptacle outlet on the roof adjacent to the equipment. The receptacle outlet shall be on the supply side of the disconnect switch. [CMC 303.9.4 (2)]

SERVICE AND ACCESS CLEARANCES TO EQUIPMENT AND APPLIANCES

Working space in front of the equipment disconnects / electrical equipment shall be 30" wide and 36" deep. Disconnect shall not be placed behind equipment. Associated electrical equipment may extend 6" into the working space. [CEC Table 110.26, 110.26(A)(3)]

Equipment and appliances shall be accessible for inspection, service, repair, and replacement without removing permanent construction.

Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, if provided. [CMC 304.1]

Unless otherwise specified, not less than thirty (30) inches in depth, width, and height of working space shall be provided. [CMC 304.1]

Exception: Unit heaters and room heaters may be installed with an eighteen (18) inch (457 mm) minimum depth working space. A platform shall not be required for unit heaters or room heaters. [CMC 304.1 Exc]

The operating instructions shall be attached to the appliance where they can be easily read. [CMC 304.1 Exc]

Access from Inside: Buildings of more than fifteen (15) feet in height shall have an inside means of access to the roof unless other means acceptable to the Authority Having Jurisdiction are provided. [CMC 304.2.1]

Door or Scuttle: The inside means of access shall be a permanent or foldaway inside stairway or ladder, terminating in an enclosure, scuttle, or trap door. [CMC 304.2.1.1]

Such scuttles or trap doors shall be at least twenty-two (22) inches x twenty-four (24) inches in size, shall open easily and safely under all conditions, especially snow, and shall be constructed so as to permit access on the inside. [CMC 304.2.1.1]

Guards or Rails: At least six (6) feet of clearance shall be available between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards a minimum of forty-two (42) inches in height shall be provided on the exposed side. [CMC 304.2.1.1]

Where parapets or other building structures are utilized in lieu of guards or rails, they shall be a minimum of forty-two (42) inches in height. [CMC 304.2.1.1]

Permanent Lighting: Permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof. [CMC 304.2.2]

Standing Water: Where water stands on the roof at the equipment, in the passageways to the equipment, where the roof is of a design having a water seal, a suitable platform, walkway, or both shall be provided above the waterline. [CMC 304.2.3]

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Such platform(s) or walkway(s) shall be located adjacent to the equipment and control panels so that the equipment can be safely serviced where water stands on the roof. [CMC 304.2.3]

ROOFTOP TERMINATIONS

Rooftop terminations shall be arranged with or provided with the following (See CMC 510.8.2.1 – Figure 5-4 below): [CMC 510.8.2.1]

A minimum of ten (10) feet of clearance from the outlet to adjacent buildings, property lines, and air intakes.

Where space limitations absolutely prevent a ten (10) foot horizontal separation from an air intake, a vertical separation shall be permitted, with the exhaust outlet being a minimum of three (3) feet above any air intake located within ten (10) feet horizontally.

The exhaust flow directed up and away from the surface of the roof and a minimum of forty (40) inches above the roof surface.

The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, structurally sound for the service to which it is applied, and will not sustain combustion.

A grease collection device that is applied to exhaust systems shall not inhibit the performance of any fan.

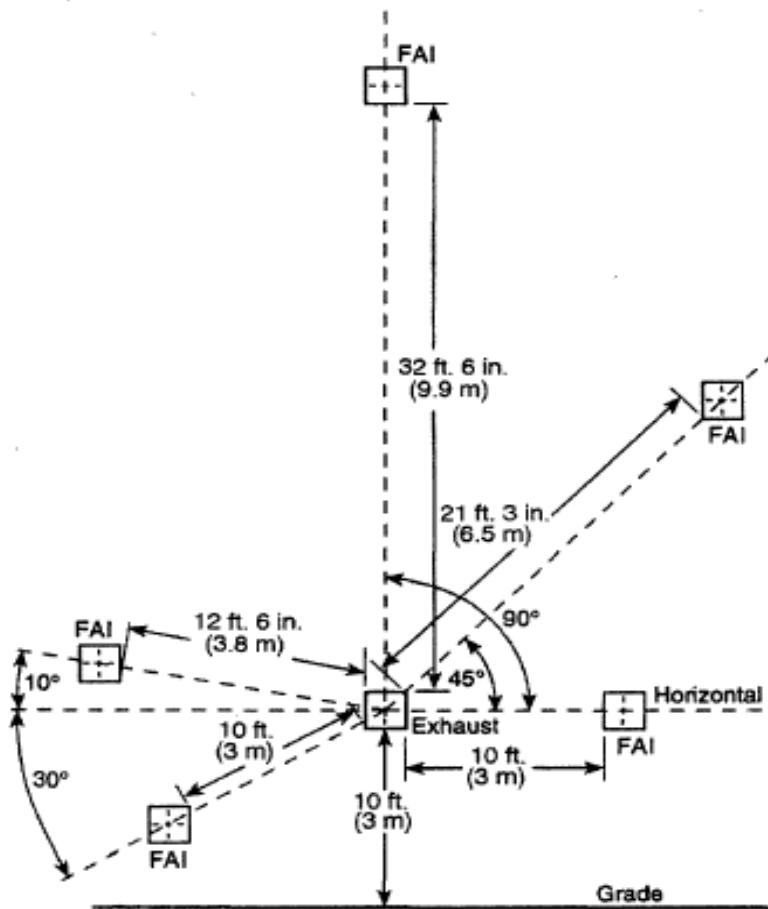
Exception: Grease containers that are evaluated for equivalency with the preceding requirements and listed as such.

A listed grease duct complying with CMC Section 510.4, or with ductwork complying with CMC Section 510.5.

A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit proper inspection and cleaning that is listed for commercial cooking equipment provided the ductwork extends a minimum of eighteen (18) inches above the roof surface and the fan discharges a minimum of forty (40) inches above the roof surface. See CMC Section 511.1.1 – Figure 5-5 below.

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FIGURE 5-4



Notes:

1. Fresh air intake (FAI) applies to any air intake, including an operable door or window.
2. Example:
 - FAI is same plane as exhaust or lower: 10 ft. [3 m (min.)] between closet edges.
 - FAI above plane of exhaust: 10 ft. + 0.25 ft. (3 m + 0.076 m) degree between closet edge.

**FIGURE 5-4
EXHAUST TERMINATION DISTANCE FROM FRESH AIR
INTAKE (FAI) OR OPERABLE DOOR OR WINDOW.
[NFPA 96:7.8.3]**

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FIGURE 5-5

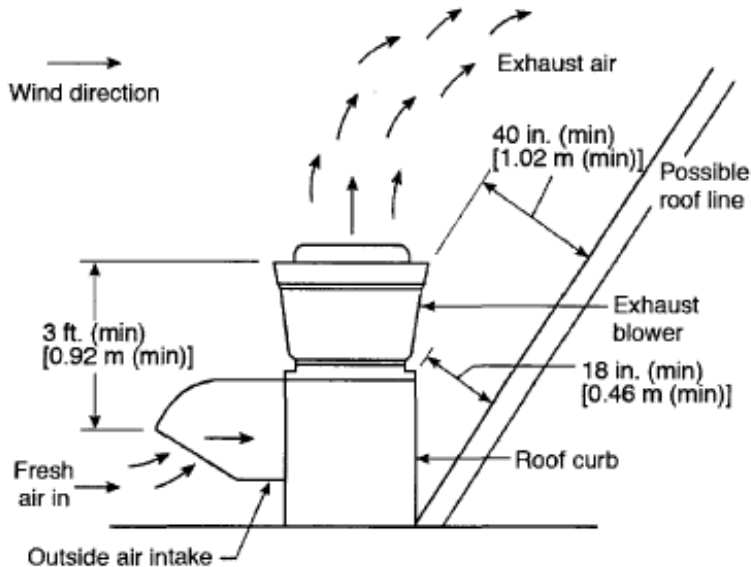


FIGURE 5-5
UPBLAST FAN CLEARANCES.
[NFPA 96:7.8.2.1]

UTILITY FANS AND DUCTS

Utility Set Exhaust Fans, if installed at the rooftop termination point, shall meet the requirements of CMC Section 510.8.2.1 (A) and Section 510.8.2.3.

If the fan is installed within the building it shall be located in an easily accessible area of adequate size to allow for service or removal.

If the duct system connected to the fan is in an enclosure, the space or room in which the exhaust fan is located shall have the same fire resistance rating as the enclosure.

The fan shall be connected to the exhaust duct by flanges securely bolted as shown in Figures 5-6(a) through 5-6(d) or by a system specifically listed for such use. Flexible connectors shall not be used. Exhaust fans shall have a drain directed to a readily accessible and visible grease receptacle not to exceed one (1) gallon (3.8 L).

ASSEMBLY AND INSTALLATION OF EQUIPMENT

Air-conditioning appliances shall be installed in accordance with the manufacturer's installation instructions. Unless the appliance is listed for installation on a combustible surface, such as a floor or roof, or unless the surface is protected in an approved manner, it shall be installed on a surface of noncombustible construction with noncombustible material and surface finish and with no combustible material against the underside thereof.

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Illumination and Service Receptacles: In addition to the requirements of Section 308.0, permanent lighting fixtures shall be installed for all equipment required by this code to be accessible or readily accessible. Such fixtures shall provide sufficient illumination to safely perform the required tasks for which access is provided. Control of the illumination source shall be provided at the access entrance. [CMC 1106.4]

Exceptions:

Lighting fixtures may be omitted when the fixed lighting of the building will provide the required illumination.

Equipment located on the roof or on the exterior walls of a building.

Cooling Towers, Evaporative Condensers, and Fluid Coolers shall be readily accessible. When located on roofs, such equipment having combustible exterior surfaces shall be protected with an approved automatic fire-extinguishing system. [CMC 1127]

Cooling Towers, Evaporative Condensers, and Fluid Coolers shall be supported on noncombustible grillage designed in accordance with the Building Code. Seismic restraints shall be as required by the Building Code. [CMC 1128]

ELECTRICAL SYSTEM REQUIREMENTS

All electrical systems shall be installed and inspected in accordance with the Electrical Code.

Vibration Switch: Equipment shall be provided with a vibration switch to shut off fans operating with excessive vibration.

Identification of Equipment: Provide permanent labeling (phenolic engraved plaque) on the unit and on the disconnect. The label shall identify panel used to energize equipment.

Disconnecting Means: Shall have a positive means to disconnect the power adjacent to the equipment. The disconnecting means is permitted to be attached to, or placed within the equipment enclosure, provided it is not attached to an access panel. The disconnect shall be in sight and readily accessible to the equipment served. [CMC 308 & CEC 440.14]

Disconnect Height: The grip of the disconnect operating handle shall not be more than 6'-7" above the floor or working platform. [CEC 404.8 (A) & 440.14]

A/C Wire, breaker and fuse shall be sized per name plate on the equipment. [CEC 440.4]

Service Receptacle: A 120 volt receptacle shall be located within 25 feet of the equipment for service. [CMC 308]

CONDENSATE DRAINS

All **Condensate Waste Drains** shall be properly trapped/air-gapped with drain terminating to an approved sanitary waste disposal location. [CMC 309.1]

Condensate lines shall not be connected to nor be allowed to drain to the storm drain system.

Condensate Control: Cooling coil or cooling unit located in attic or furred space requires an additional watertight pan of corrosion resistant metal beneath the cooling coil unit top to catch the overflow condensate due to a clogged primary condensate drain or;

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One pan with a standing overflow and a separate secondary drain may be provided in lieu of the secondary drain pan. [CMC 309.2]

The additional pan or standing overflow shall be provided with a minimum $\frac{3}{4}$ " nominal drain pipe discharging at a point which can be readily observed. [CMC 309.2]

PLUMBING VENT TERMINATION

Vent Termination: All vent pipes shall terminate not less than 6" above roof nor less than 12" away from any vertical surface **including rooftop equipment** OR extend above. [CPC 309.1]

Gas Test: Provide gas test as applicable when gas pipe is altered/changed.

Gas Pipe shall be seismically braced at equipment. (See example **FIGURE A-3**)

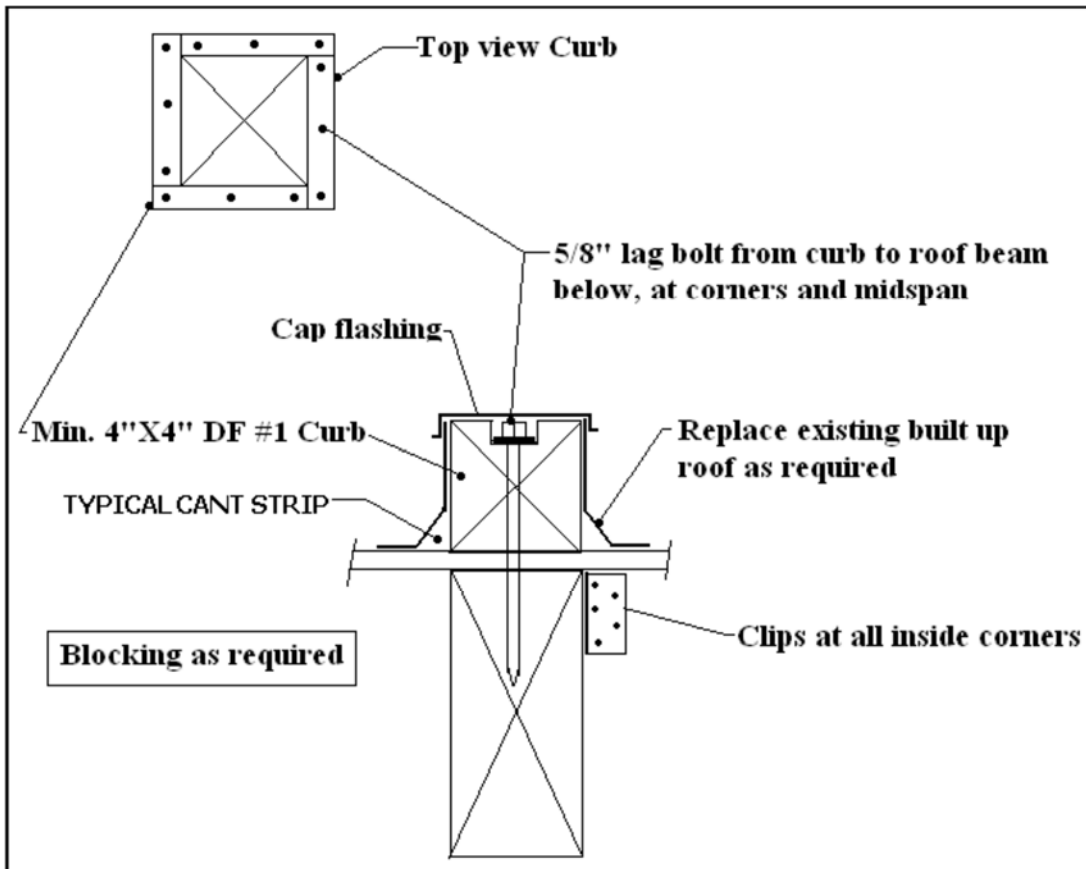
Exterior Metallic Gas Piping and fittings shall be coated with corrosion-resistant material. [CPC 1208.5.6 & CMC 1309.5.6]

Roof Top Piping and Metal Conduit: Electrical RMC, gas, and plumbing piping shall be secured a minimum of 4" above the roof with listed piping supports, spaced no more than 10' on center and secured within 3' of every box or termination fitting.

Listed piping supports shall be secured to roof with compatible roofing adhesive according to manufacturer's installation instructions. (See **FIGURE A-2**)

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FIGURE A-1: Arcata Approved Roof Equipment Curb Installation



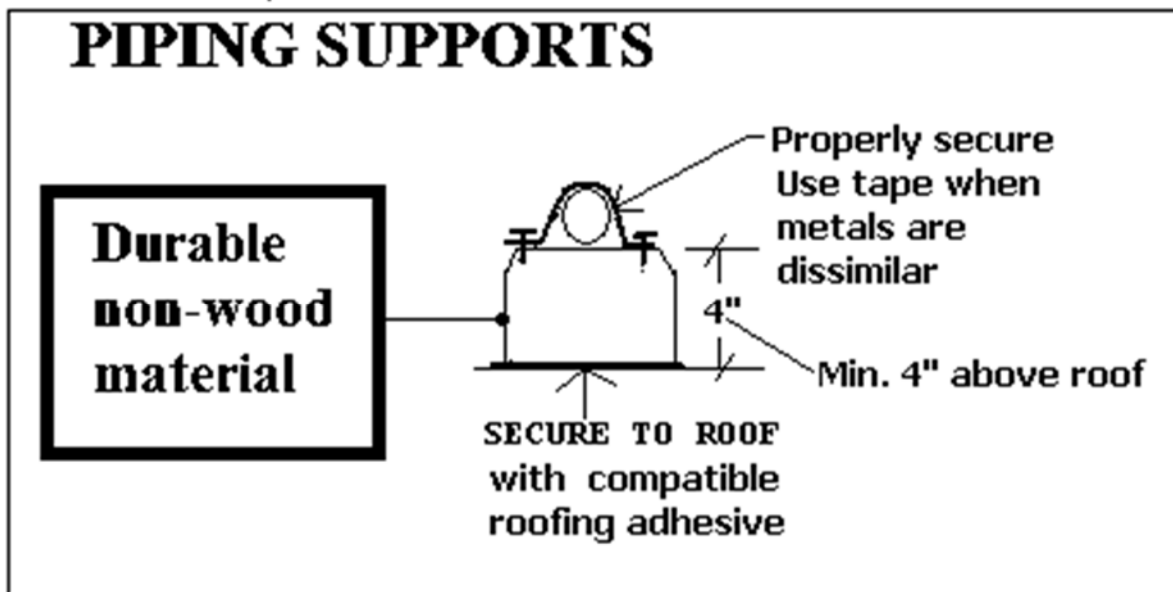
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Table 7.2.6.2: Support of Piping

Steel Pipe Nominal Size of Pipe (in.)	Spacing of Supports (ft)	Nominal Size of Tubing Smooth Wall (in. O.D.)	Spacing of Supports (ft)
½	6	½	4
¾ or 1	8	¾ or 1	6
1 ¼ or larger (horizontal)	10	¾ or 1 (horizontal)	8
1 ¼ or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

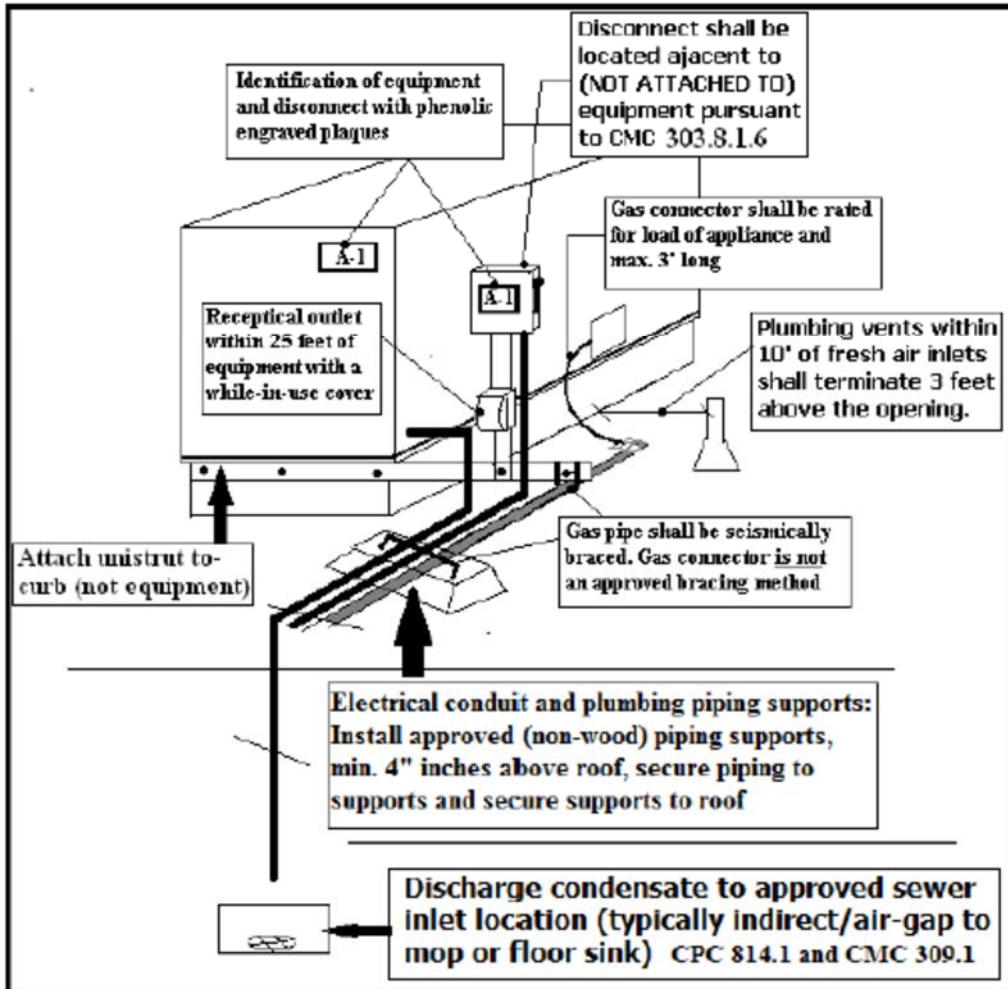
NOTE: For SI units, 1 ft = 0.305 m.

FIGURE A-2: Required Piping Supports



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FIGURE A-3: Example of Rooftop Installation Requirements



CONDENSATE WASTES AND CONTROL

Condensate Disposal. Condensate from air washers, air-cooling coils, fuel-burning condensing appliances, the overflow from evaporative coolers, and similar water-supplied equipment or similar air-conditioning equipment shall be collected and discharged to an approved plumbing fixture or disposal area. If discharged into the drainage system, equipment shall drain by means of an indirect waste pipe (typically indirect/air-gap to mop or floor sink). The waste pipe shall have a slope of not less than one-eighth (1/8) inch per foot (10.4 mm/m) or 1 percent slope and shall be of approved corrosion-resistant material not smaller than the outlet size as required in Table 8-2 for air-cooling coils or condensing fuel-burning appliances, respectively. Condensate or wastewater shall not drain over a public way. [CPC 814.1 & CMC 309.1]

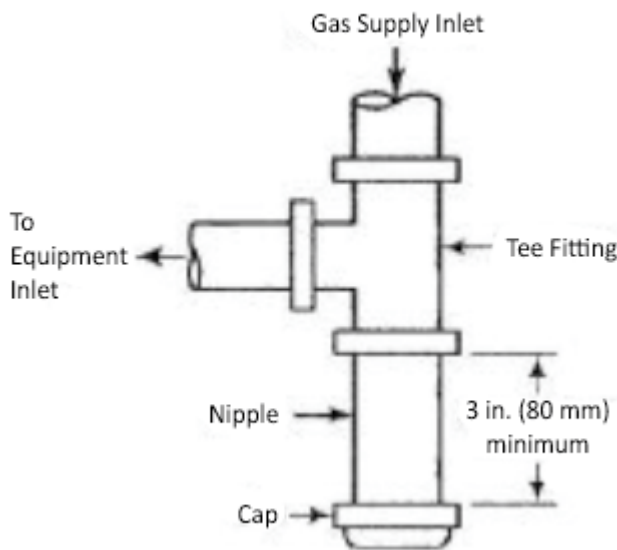
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CPC TABLE 8-2: Minimum Condensate Waste Pipe Size

EQUIPMENT CAPACITY IN TONS OF REFRIGERATION (kw)		MINIMUM CONDENSATE PIPE DIAMETER IN INCHES (mm)	
Up to 20	(Up to 70.34)	¾	(20)
21-40	(73.85-140.67)	1	(25)
41-90	(144.19-316.5)	1¼	(32)
91-125	(320.03-439.6)	1½	(40)
126-250	(443.12-879.2)	2	(50)

CPC 1212.7 Sediment Trap. Where a sediment trap is not incorporated as a part of the gas utilization appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical at the time of appliance installation. The sediment trap shall be either a tee fitting with a capped nipple in the bottom outlet, as illustrated in Figure 12-1, or other device recognized as an effective sediment trap. Illuminating appliances, ranges, clothes dryers, decorative vented appliances for installation in vented fireplaces, gas fireplaces, and outdoor grills shall not be required to be so equipped

CPC 1212.1 Connecting Gas Appliances



Aluminum alloy tubing shall not be used in exterior locations. [NFPA 54:9.6.1(2)]