2025-26 CALBO Training Institute

2025 California Mechanical Code: Code Changes & Review

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The information herein is provided for educational purposes only and shall not be treated as an official interpretation of the referenced codes or standards. Always refer to the complete code or standard when installing, replacing, or repairing any plumbing or mechanical system.

This course is approved by The American Institute of Architects (AIA) for 6 Learning Units and International Code Council Preferred Provider Program (ICC PPP) for 0.6 Continuing Education Units.

- AIA: 6 LU I HSWs (Course Number - 24: 2025)
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Learning Objectives

- Identify and explain the most significant changes in the 2025 CMC compared to the 2022 edition.
- Understand the reasoning behind these updates and their impact on mechanical system design, installation, and code enforcement.
- Evaluate how the new regulations affect compliance requirements for contractors, inspectors, engineers, and other industry professionals.
- Apply the updated code standards to real-world mechanical scenarios to ensure safety and regulatory adherence.
- Discuss best practices for integrating the revised CMC regulations into mechanical projects and inspections.

******Chapter Matrices have not been included in the handout to save printing cost. Please consider purchasing the 2025 California Mechanical Code or visiting the read-only version by scanning the QR code.**

Within the Content of This Handout…
Added Code Text will be underlined
Removed Code Text will be struck out
California Code and Code Changes will be italicized.

Chapter 1 Administration

1.10.6 OSHPD 6.

Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 6

***Application** – Chemical dependency recovery hospital not within an acute care hospital building or an acute psychiatric facility.*

***Enforcing Agency** – Local building department.*

1.10.6.1 Applicable Administrative Standards.

1. Title 24, Part 1, California Code of Regulations: Chapter 7.

2. Title 24, Part 2, California Code of Regulations: Section 1.1.0 and 1.10.0, Chapter 1 Division I, and as indicated in the adoption matrix for Chapter I, Division II.

***1.10.6.2 Applicable Building Standards.** California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provision of Title 24, Part 2, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.6.

***Authority Cited** – Health and Safety Code Sections 1275, 18929 and 129850.*

***References** – Health and Safety Code Sections 1250.3 and 129675-130070.*

***1.10.6.3 Adopting Agency Identification.** The provisions of this code applicable to buildings identified in this Subsection 1.10.6 will be identified in the Matrix Adoption Tables under the Acronym OSHPD 6.*

Chapter 2 Definitions

203.0 Air

- **Air, Recirculated.** Air that is removed from a conditioned space or zone and reused as supply air.
- **Air, Return.** Air from the conditioned space or zone that is returned through ducts or plenums to the conditioning equipment for reconditioning.
- **Air, Supply.** Air being conveyed to a conditioned space or zone through ducts or plenums from a heat exchanger of a heating, cooling, absorption, or evaporative cooling system.
- **Air, Transfer.** Air that is relocated from one conditioned space or zone to another space through ducts, plenums, or transfer grills.
- 203.0 Air
- **Air Exfiltration.** Leakage of air from a conditioned space(s) to an unconditioned space(s) or to the outdoors through openings in the building envelope, often attributable to wind pressure, stack pressure, or positive pressurization of the building. Also known as air leakage.

- **Air Infiltration.** Leakage of outdoor air or air from an unconditioned space(s) into a conditioned space(s) through openings in the building envelope, often attributable to wind pressure, stack pressure, or negative pressurization of the building. Also known as air leakage.

203.0 Air
Air Terminal Device. [OSHPD 1, 2, 3, 4 & 5] *Any device (e.g., grille, register, diffuser) placed in an opening to a room, through which controlled air enters or leaves. Component of the air-distribution system which has the purpose of achieving the predetermined movement of air into or from a treated space*

203.0 Appliance
A device that utilizes fuel or electricity as an energy source to produce light, heat, power, refrigeration, or air conditioning. This definition also includes vented decorative appliances and electric storage or tankless water heat.

Appliance, Vented. An appliance designed and installed in such a manner that all products of combustion are conveyed directly from the appliance to the outdoor atmosphere through an approved chimney or vent system.

204.0 Backflow
The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from sources other than its intended source.

204.0 Borehole
A vertical or horizontal shaft typically cored, drilled or bored into the earth for geothermal system installations.

205.0 Chilled Water.
Water or fluid that is cooled below the surrounding air temperature via mechanical or other means for the purpose of removing excess heat from conditioned spaces or equipment via hydronic piping distribution.

205.0 Conditioned Space
An area, room, space, or zone being heated or cooled by an appliance or equipment.

205.0 Corridor Damper
An automatic closing metal assembly consisting of one or more louvers, blades, slats, or vanes that closes upon detection of heat or smoke as to restrict the passage of flame and smoke used where air ducts penetrate horizontal openings in fire-resistance-rated corridors.

206.0

- **Direct Exchange (DX).** A ground-source heat pump that circulates a refrigerant through a closed-loop system. Also known as direct expansion unit or direct expansion system.
- **Driver Building.** One or more building(s) or facility(ies) that determined the upper and lower temperature limits of hot fluid or cold fluid delivery system.
- **Dual Purpose Water Heater.** An appliance intended to be a heat source for both space heating and domestic hot water applications.

206.0 Duct Environment Air.
Ducting used for conveying air at temperatures not exceeding 250°F (121°C) to or from occupied areas of any occupancy through other than heating or air-conditioning systems, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, locker room exhaust ducts, shower room exhaust ducts, janitor's closet exhaust ducts, and domestic-type clothes dryer exhaust ducts.

206.0 Duct Sealing.
The use of approved adhesives, gaskets, tape, mastics, or combination thereof to close openings in the surface of the ductwork, field erected plenums, equipment, and casings through which air leakage would occur, or the use of continuous welds.

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206.0 Duct Sealing Classes.

- Seal Class A. All transverse joints, longitudinal seams, and duct wall penetrations.
- Seal Class B. All transverse joints and longitudinal seams.
- Seal Class C. Transverse joints.

207.0 Energy Recovery Ventilation (ERV) System.
A device intended to provide outdoor ventilation air, and in the process transfer energy between the intake and exhaust airstreams for the purpose of preheating, precooling, humidifying, or dehumidifying outdoor ventilation air prior to supplying such air to a conditioned space.

207.0 Engineering Methods
Design methods that rely on the application of mathematics, sciences, empirical evidence, and engineering principles. [NFPA 54:3.3.34]

207.0 Expansion Tank.
A vessel used to protect closed systems from excessive pressure.

208.0 Fire Barrier
A fire-resistance-rated wall or assembly of materials designed to restrict the spread of fire in which continuity is maintained.

208.0

- **Flue Collar.** That portion of an appliance designed for the attachment of a draft hood, vent connector, or venting system. [NFPA 54:3.3.44]
- **Fume Incinerators.** Devices that use intense heat or fire to break down, oxidize, or both, vapors and odors contained in gases or air being exhausted into the atmosphere. {NFPA 96:3.3.27}

209.0 Gas
A substance used as fuel, such as natural, liquefied petroleum (LP-Gas), and mixtures of these gases, with gas-air mixtures within the flammable range. …

Flue Gas. Products of combustion with excess air in appliance flues or heat exchangers. [NFPA 54:3.3.49.1] …

209.0

- **GeoMircoDistrict.** A collection of building and facilities on an independently pumped ambient temperature loop (ATL) that supplies or receives energy. An independent segment served by a thermal highway.
- **Geothermal Energy System.** A system that exchanges thermal energy between the earth, subsurface water, and/or bodies of water, for the purposes of space heating and cooling, and/or water heating.
- **Geothermal Energy System, Open-Loop.** An open-loop geothermal energy system draws in surface or ground water, passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment.
- **Geothermal Energy System, Closed-Loop.** A closed-loop hydronic geothermal system that uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels.

210.0 Heat~~(Energy)~~ Recovery ~~Ventilator~~ Ventilation (HRV) System.
A device intended to remove air from buildings, replace it with outside air, and in the process transfer heat from the warmer to the colder airstreams.

210.0 Health Facilities. [OSHPD 1, 1R, 2, 3, 4, 5 & 6]
Buildings specified within the statutory authority of the Department of Health Care Access and Information/Office of Statewide Hospital Planning and Development.

210.0 Hydronic Systems
Relating to, or being a system of, heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

Hydronic System, Ambient Temperature Loop (ATL).
Hydronic System, Closed-Loop.
Hydronic System, District Ambient Temperature Loop.
Hydronic System, Fifth Generation (5G) System Configurations.
Hydronic System, Fourth Generation (4G) System Configurations.
Hydronic System, Geothermal Closed-Loop.
Hydronic System, Geothermal Open-Loop.
Hydronic System, Non-Oxygen Barrier Closed-Loop.
Hydronic System, Open-Loop.
Hydronic System, Vented Closed-Loop.

212.0 Joint, Heat Fusion
A joint used in some thermoplastic systems to connect the pipe to fittings or pipe lengths directly to one another (butt-fusion). This method of joining pipe to fittings includes butt-fusion, socket-fusion, electro-fusion, and saddle-fusion. This method of welding involves the application of heat and pressure to the components, allowing them to fuse together forming a bond between the pipe and fitting

215.0

- **Mechanical System.** A set of components, devices, appliances, and equipment intended to perform a function(s) for which the system is designed, as regulated by this code.
- **Mid-Story Guide.** A support designed to keep piping in alignment, located mid-way between floors or a floor and ceiling

218.0 PEL (Permissible Exposure Limit).
The time-weighted average concentration [set by the U.S. Occupational Safety and Health Administration (OSHA)] for a normal 8-hour workday and a 40- hour workweek to which nearly all workers can be repeatedly exposed without adverse effect. Chemical manufacturers publish similar recommendations [e.g., acceptable exposure level (AEL), industrial exposure limit (IEL), or occupational exposure limit (OEL), depending on the company], generally for substances for which PEL has not been established. [ASHRAE 34:3] ~~The maximum permitted time-weighted average exposures to be utilized are those published in 29 CFR 1910.1000~~

Scan QR code to view for OSHA's PEL Tables.

218.0 <u>Pressure, Design.</u>
<u>The maximum allowable pressure for which a specific part of a system is designed.</u>

218.0 <u>Pressure, Design(Refrigeration).</u>
<u>The maximum allowable pressure for which a specific part of a refrigeration system is designed.</u>

220.0

- **Thermal Highway.** A collection one or more GeoMicroDistricts that acts as an energy transport system and supplies or accepts energy from multiple GeoMicroDistricts, individual buildings, or other sources. Also known as convective circulation circuit.
- **Thermal Resources**. A source for a heating and a sink for a cooling. There are two types of sources:

  (1) Conventional-type: such systems are known as geothermal energy systems, such as air-source resources and ground-source resources.
  (2) Opportunistic-type: such systems use water-source resources (e.g., oceans, rivers, raw sewage pipes, treated sewage outfall, potable water pipes, etc.), process byproduct heat resources (e.g., data center cooling process reject heat, industrial process reject heat, etc.), and other resources.
  Thermosiphon. The natural circulation of fluids due to temperature differential.

224.0 <u>Vent.</u>
<u>A pipe or other conduit composed of factory-made components, containing a passageway for conveying combustion products and air to the atmosphere, listed and labeled for use with a specific type or class of appliance.</u>

224.0 <u>Vent, Type B Gas.</u>
A factory-made gas vent listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn only gas.

224.0 Vent, Type B-W Gas.
A factory-made gas vent listed by a nationally recognized testing agency for venting listed or approved gas-fired vented wall furnaces.

224.0 Vent, Type L Gas.
A venting system consisting of listed vent piping and fittings for use with oil-burning appliances listed for use with Type L or with listed gas appliances.

Chapter 3 General Regulations

304.4.1 Length of Passageway.
Where the height of the passageway is less than 6 feet (1829 mm), the distance from the passageway access to the appliance shall not exceed 20 feet (6096 mm) measured along the centerline of the passageway. [NFPA 54:9.5.1.1] Where the height of the passageway is 6 feet (1829 mm) or more, the distance from the passageway access to the appliance shall not exceed 50 feet (15 240 mm) measured along the centerline of the passageway.

310.2 Condensate Control.
Where any equipment or appliance is installed in a space where damage is capable of resulting from condensate overflow, a drain line shall be provided and shall be drained in accordance with Section 310.1. An additional protection method for condensate overflow shall be provided in accordance with one of the following:

(1) A water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked. Such detecting device shall be in accordance with the manufacturer's installation instructions.
(2) An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain
(3) An additional separate drain line at a level that is higher than the primary drain line connection of the drain pan.
(4) An additional watertight pan of corrosion-resistant material with a water level detection device installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment. The additional pan or the additional drain line connection shall by provided with a drain pipe of not less than ¾ of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

311.2 Air Filters.
Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high-efficiency particulate filters shall comply with Section 935.0.
Exceptions:
(1) Air filters used in systems ~~Systems~~ serving single guest rooms or dwelling units shall not be required to be ~~require a~~ listed ~~filter~~.
(2) Air filters used in listed appliances and in accordance with the manufacturer's instructions.

311.2.1 Minimum Filtration.
In mechanically ventilated buildings, occupied areas of the building shall be provided with air filtration media for outside and return air that provides not less than a Minimum Efficiency Reporting Value (MERV) of 13 or as required by the Authority Having Jurisdiction. Installed filters shall be clearly labeled by the manufacturer indicating MERV rating.

321.0 Essential Mechanical Provisions. [OSHPD 1, 2, 3 (Surgical Clinics only) 4 & 5]
***321.3** Cooling equipment necessary to maintain temperature and humidity listed in Table 4-A for a minimum of one operating room and other spaces as identified in the functional program.*

322.0 Sensitive Areas or Rooms. [OSHPD 1, 2, 3 (Surgical Clinics) 4 & 5]
The following are sensitive areas or rooms:
(1) Operating room
(2) Hybrid operating room
(3) Cesarean operating room
(4) Delivery room
(5) Surgical Cystoscopy
(6) Class 3 imaging
(7) Cardiac catheterization lab
(8) Trauma/cardiac room
(9) Post-anesthesia care unit
(10) Intensive care
(11) Newborn intensive-care nursery unit
(12) Newborn nursery
(13) Burn unit
(14) Protective Environment Room
(15) Procedure room
(16) Class 2 imaging
(17) Gastrointestinal endoscopy procedure room

Chapter 4 Ventilation air

401.2 Indoor Swimming Pools.

The design of ventilation systems serving an indoor aquatic facility(natatorium) shall comply with the Uniform Swimming Pool, Spa, and Hot Tub Code(USPSHTC).

402.1 Occupiable Spaces.

Occupiable spaces listed in Table 402.1 shall be designed to have ventilation (outdoor) air for occupants in accordance with this chapter. *[DSA-SS ~~& DSA-SS/CC~~] Ventilation air requirements for occupancies regulated by the California Energy Commission are found in the California Energy Code.*

***[CEC]** Ventilation air requirements for occupancies regulated by the California Energy Commission and found in the California Energy Code supersede those of the California Mechanical Code.*

***[OSHPD 1, 2, 3, 4 & 5]** Health care spaces shall meet the ventilation requirements found in Table 4-A. Ventilation rates for areas not specified in Table 4-A shall have minimum ventilation and air change rates per ANSI/ASHRAE Standard 62.1. Where areas with prescribed ventilation rates in both Standards 62.1 and Table 4-A exist, the higher of the two air change rates shall be used.*

402.1.2 Ventilation in Health Care Facilities.

Mechanical ventilation for health care facilities shall be designed and installed in accordance with this code, and ASHRAE 170, and NFPA 99.

402.2 Natural Ventilation Procedure. ***[Not permitted for OSHPD 1, 2, 3, 4 & 5]***

- Guidelines have been added to the UMC for designing areas that use natural ventilation in lieu of mechanical ventilation. The design requirement are based on the following:
- Ceiling height
- Floor area
- Opening locations
- Opening sizes
- TABLE 402.2.1.6(A)(1) and TABLE 402.2.1.6(A)(2) have been added to assist in this design.

402.4 Outdoor Air Intake ~~Protection~~.

~~Required outdoor air intakes shall be covered with a corrosion-resistant screen having not less than 1⁄4 of an inch (6.4 mm) openings, and shall have not more than 1⁄2 of an inch (12.7 mm) openings.~~

Ventilation system outdoor air intakes shall be designed in accordance with Section 402.4.1 through Section 402.4.5. [ASHRAE 62.1:5.5]

~~402.4.1 Weather Protection.~~

~~Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment, to prevent rain intrusion, and manage water from snow in accordance with ASHRAE 62.1.~~

402.4.1 Location.

Outdoor air intakes (including openings that are required as part of a natural ventilation system) shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source listed in Table 402.4.1 shall be equal to or greater than the following:

(1) The separation distance in Table 402.4.1 or

(2) The calculation methods in ASHRAE 62.1 Normative Appendix B and shall comply with all other requirements of this section. [ASHRAE .162.1:5.5.1]

TABLE 402.4.1
AIR INTAKE MINIMUM SEPARATION DISTANCE
[ASHRAE 62.1:TABLE 5-1]

OBJECT	MINIMUM DISTANCE (feet)
Class 2 air exhaust/relief outlet	10
Class 3 air exhaust/relief outlet	15
Class 4 air exhaust/relief outlet	30
Cooling tower exhaust	25
Cooling tower intake or basin	15
Driveway, street, or parking place	5
Garage entry, automobile loading area, or drive-in queue	15
Garbage storage/pick-up area, dumpsters	15
Plumbing vents terminating at least 3 feet above the level of the outdoor air intake	3
Plumbing vents terminating less than 3 feet above the level of the outdoor air intake	10
Roof, landscaped grade, or other surface directly below intake	1
Thoroughfare with high traffic volume	25
Truck loading area or dock, bus parking/idling area	25
Vents, chimneys, and flues from combustion appliances and equipment	15

For SI units: 1 foot = 304.8 mm

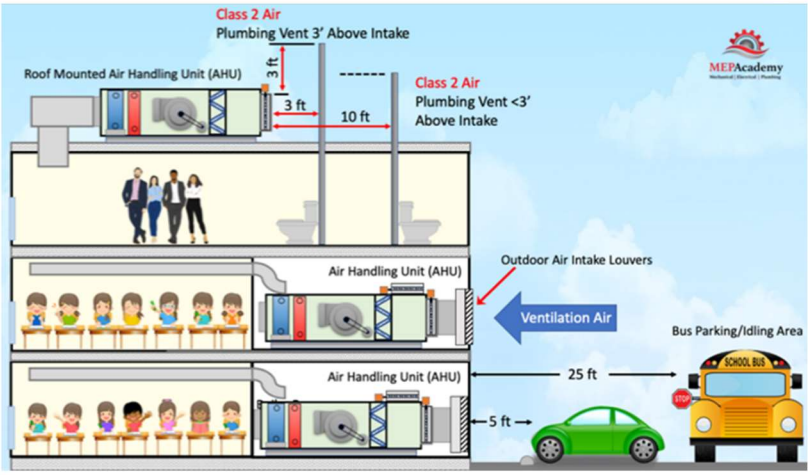


Image retrieved 04/07/2025 from: https://mepacademy.com/outdoor-air-intake-locations-air-classifications/

402.4.1.1 Exhaust/Relief Outlets.

Separation criteria for Class 2 and Class 3 exhaust/relief outlets apply to the distance from the outdoor air intakes for one ventilation system to the exhaust and relief outlets for any other ventilation system. [ASHRAE 62.1:5.5.1.1]

402.4.1.2 Fuel-Burning Equipment.

The minimum distances relative to fuel-fired appliances shall be as required by ANSI Z223.1/NFPA 54 for fuel gas-burning appliances and equipment, NFPA 31 for oil burning appliances and equipment, and NFPA 211 for other combustion appliances and equipment.[ASHRAE 62.1:5.5.1.2]

402.4.1.3 Roof, Landscaped Grade, or Another Surface Directly Below Intake.

Where snow accumulation is expected, the surface of the snow at the expected average snow depth shall be considered to be a surface directly below an intake. [ASHRAE 62.1:5.5.1.3] Exception: The minimum separation distance in Table 402.4.1 shall not apply where outdoor surfaces below the air intake are sloped more than 45 degrees from horizontal or where such surfaces are less than 1 inch (30 mm) in width.

402.4.1.4 Laboratory Exhaust.
Separation criteria for fume hood exhaust shall be in compliance with ANSI/ASSP Z9.5. [ASHRAE 62.1:5.5.1.4]

402.4.2 Rain Entrainment.
Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment in accordance with one or more of the following:

(1) Limit water penetration through the intake to 0.07 oz/ft2 ·h (21.5 g/m2 ·h) of inlet area when tested using the rain test apparatus described in UL 1995.
(2) Select louvers that limit water penetration to a maximum of 0.01 oz/ft2 (3 g/m2) of louver free area at the maximum free area intake velocity through the louver. This water penetration rate shall be determined when subjected to the water penetration test in AMCA 500-L or equivalent. Manage the waterthat penetrates the louver by providing a drainage area or moisture removal devices
(3) Select louvers that are Class A when rated according to AMCA 511 and tested per the AMCA 500-L wind-driven rain test when subjected to a simulated rainfall of 3 inches (75 mm) per hour and a 29 mph (13 m/s) wind velocity. The maximum design core area velocity through the louver shall correlate to a Class A rating.
(4) Use rain hoods sized for no more than 500 fpm (2.5 m/s) face velocity with a downward-facing intake such that all intake air passes upward through a horizontal plane that intersects the solid surfaces of the hood before entering the system.
(5) Manage the water that penetrates the intake opening by providing a drainage area or moisture removal devices. {ASHRAE 62.1:5.5.2}

402.4.3 Rain Intrusion.
Air-handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in UL 1995. [ASHRAE 62.1:5.5.3]

402.4.4 Snow Entrainment.
Where climate dictates, outdoor air intakes that are part of the mechanical ventilation system shall be designed as follows to manage water from snow that is blown or drawn into the system:

(1) Access doors to permit cleaning of wetted surfaces shall be provided.
(2) Outdoor air ductwork or plenums shall pitch to drains designed in accordance with the requirements of ASHRAE 62.1. [ASHRAE 62.1:5.5.4]

402.4.5 Bird Screens.
Outdoor air intakes shall include a screening device designed to prevent penetration by a 0.5 inch (13 mm) diameter probe. The screening device material shall be corrosion resistant. The screening device shall be located, or other measures shall be taken, to prevent bird nesting within the outdoor air intake. [ASHRAE 62.1:5.5.5]

403.2 Zone Calculations.
The UMC has added calculation guidelines for zone calculations in stratified air distribution systems and personal ventilation systems.

Stratified air distribution requirements include:
Supply air must be a minimum of 4° F less than average room temperature
Return openings must be a minimum of 9’ from the floor
Air must not be mechanically mixed
Air shall be protected from impinging airstreams

Personalized ventilation Systems
Air velocity must be a maximum of 50 fpm at the head of the occupant
Return openings must be a minimum of 9’ from the floor

TABLE 403.9- AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS

TABLE 403.9
AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS
[ASHRAE 62.1: TABLE 6-3]

DESCRIPTION	AIR CLASS
Kitchen grease hoods	4
Kitchen hoods other than grease	3
Diazo printing equipment discharge	4
Hydraulic elevator machine room	2
Laboratory hoods	4
Paint spray booths	4
Refrigerating machinery rooms	3

Table has been added to assist table 402.1 and 403.7 in identifying air classifications.

403.10 Air Balance.
All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

Exception: For single family residential, compliance with Section 403.10 shall not be required.

405.4 Kitchen Exhaust.
A mechanical exhaust system that discharges directly to the outdoors shall be provided in each kitchen. The fan shall run intermittently (on demand) or continuously. A readily accessible manual control designed to be operated as needed or an automatic control shall be provided for intermittent operations.

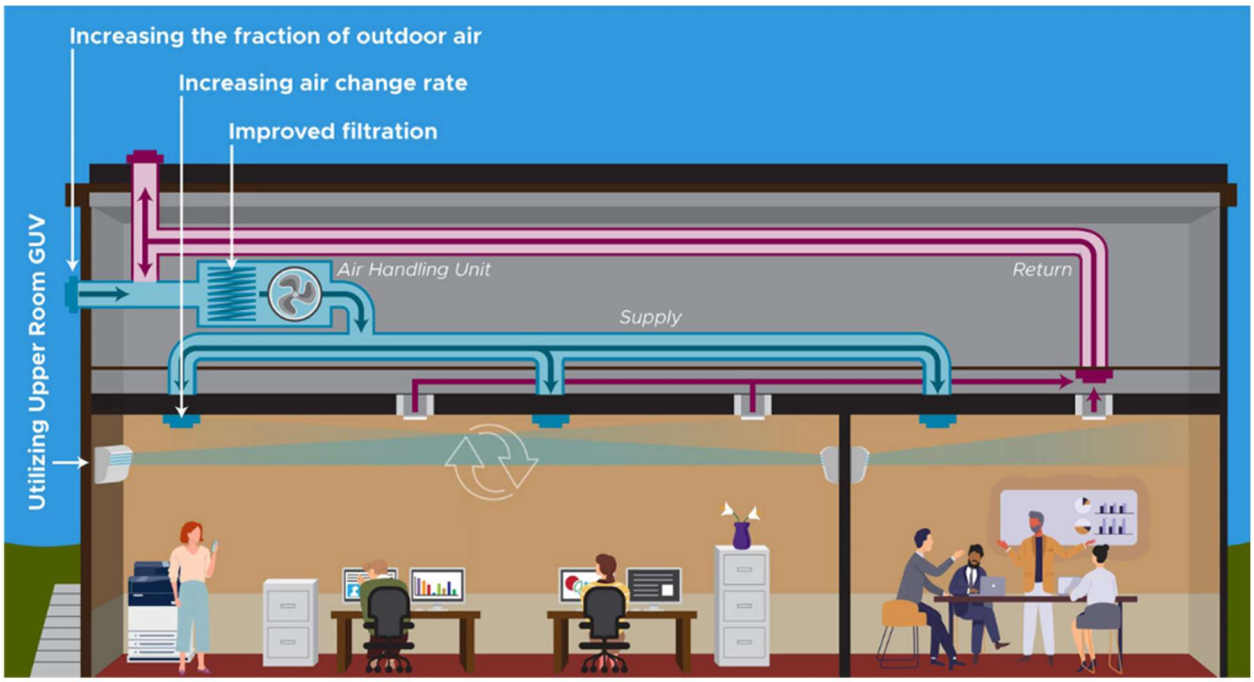
Exception: Recirculating systems installed in accordance with Section 516.0 and the manufacturer’s installation instructions.

405.4.1 Exhaust Rate.
For intermittent-controlled operations, the exhaust rate shall be not less than 100 ft^3 /min (47.2 L/s) for rangehoods or 300 ft^3 /min (142 L/s) for mechanical exhaust fans including downdraft appliances. For continuous operated ventilation, the exhaust rate shall be not less than ~~5 air changes per hour based on kitchen volume for enclosed kitchens~~ 50 ft^3 /min (23.6 L/s).

407.2.2 Exhaust Outlets.

407.2.2.1 Hazardous Exhaust Outlets. *Hazardous exhaust outlets from airborne infection isolation rooms, bronchoscopy and sputum collection exhaust, hazardous drug compounding, morgues, autopsy rooms and laboratory chemical fume hoods shall discharge a minimum of 10 feet (3048 mm) above the adjacent roof surface and a minimum of 30 feet (9144.mm) from outdoor air intakes, building openings and areas normally accessible to the public.*

407.4 Air Circulation



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407.7 Unoccupied Turndown

TABLE 4-A
PRESSURE RELATIONSHIP AND VENTILATION REQUIREMENTS FOR GENERAL ACUTE CARE HOSPITALS, SKILLED NURSING FACILITIES, INTERMEDIATE CARE FACILITIES, OUTPATIENT FACILITIES, LICENSED CLINICS, CORRECTIONAL TREATMENT CENTERS, AND ACUTE PSYCHIATRIC HOSPITALS [OSHPD 1, 2, 3, 4 & 5]

Function of Space (ee)	Pressure Relationship *(d)*(n)	Minimum Outdoor ach	Minimum Total ach	Exhausted Directly to Outdoors (j)	Recirculated Room Units (a)	Unoccupied Turndown	Design Relative Humidity (k), %	Design Temperature (l), °F/°C
NURSING UNITS AND OTHER PATIENT CARE AREAS								
AII anteroom *(1224.14.3.3)* (u)	(e)	NR	10	Yes	No	*No*	NR	NR
AII room *(1224.14.3)* (u)	Negative	2	12	Yes	No	*No*	Max 60	70-75/21-24
AII treatment/exam room (1224.4.4.1.3)	*Negative*	*2*	*12*	*Yes*	*No*	*No*	*Max 60*	*70-75/21-24*
Cesarean Delivery room *(1224.32.3.1.1)* (m), (o)	Positive	4	20	NR	No	Yes	20-60	68-75/20-24
Delivery room (1224.32.3.2) (m), (o)	*Positive*	*4*	*20*	*NR*	*No*	*Yes*	*20-60*	*68-75/20-24*
Emergency department exam/treatment room *(1224.33.3.6)* (p)	NR	2	6	NR	NR	Yes (ff)	Max 60	70-75/21-24
Emergency department human decontamination *(1224.33)*	Negative	2	12	Yes	No	*No*	NR	NR

407.7.1 *Where indicated with a "yes" in the Unoccupied turndown column of Table 4-A, the number of air changes shall be permitted to be reduced. The following conditions shall be met:*

(1) The number of air changes may be reduced to 25 percent of the indicated value in Table 4-A for pressurized spaces when the room is unoccupied.

(2) The number of air changes per hour indicated is reestablished whenever the space is occupied.

(3) The pressure relationship with surrounding rooms is maintained when the air changes per hour are reduced.

(4) All operating, class 3 imaging and cesarean delivery rooms shall maintain a minimum of six air changes per hour of total air when not in use.

407.8 Building Pressurization.

407.8 Building Pressurization.

407.8.1 *The outdoor air intake design for air handling systems shall be set to maintain the intake air rate to equal or exceed the building exhaust under all conditions including variable air volume and unoccupied turndown.*

408.5 Filters for Recirculating Room Units.

408.5 Filters for Recirculating Room Units.

408.5.1 *Filters for recirculating room units shall comply with Section 407.4.5. Where Table 4-A does not permit air recirculated by means of room units, room units with filtration per Table 4-B are permitted.*

Ventilation Air- Table Updates
The following Tables have significant updates:
TABLE 4-A
TABLE 4-B
TABLE 402.1
TABLE 403.2.2
TABLE 403.7

Chapter 5 Exhaust systems

502.2 Termination of Exhaust Ducts.
Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.34. Classes of air shall be as defined in Section 203.0 and classified in Section 403.9.

502.2.1 Environmental, Class 1, and Class 2 Air Ducts.
Environmental, Class 1, and Class 2 air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, ~~10 feet (3048 mm) from a forced air inlet,~~ 10 feet (3048 mm) above a public ~~walk~~way, ~~and~~ 3 feet (914 mm) from openings into the building, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1. The discharge of ~~environmental~~ dryer exhaust ducts shall not terminate over ~~be directed onto~~ a public ~~walk~~way or over an area where condensate or vapor could create a nuisance or hazard.

502.2.2 Class 3 Air Ducts.
Class 3 air duct exhaust shall terminate not less than 10 feet (3048 mm) from a property line, 3 feet (914 mm) from exterior walls or roofs that are in the direction of the exhaust discharge, 10 feet (3048 mm) from openings into the building, 10 feet (3048 mm) above adjoining grade, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1.

~~502.2.2~~ 502.2.3 Product Conveying, Flammable, and Class 4 Air Ducts.
Ducts conveying Class 4 air or explosive or flammable vapors, fumes, or dusts shall terminate not less than 30 feet (9144 mm) from a property line, 10 feet (3048 mm) from openings into the building, 6 feet (1829 mm) from exterior walls or roofs that are in the direction of the exhaust discharge, 30 feet (9144 mm) from combustible walls or openings into the building that are in the direction of the exhaust discharge, and 10 feet (3048 mm) above adjoining grade, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1

~~502.2.2~~ 502.2.3 Product Conveying, Flammable, and Class 4 Air Ducts.
Exception: Type I Hood exhaust termination shall be in accordance with Section 510.9.1. ~~Other product-conveying outlets shall terminate not less than 10 feet (3048 mm) from a property line, 3 feet (914 mm) from exterior walls or roofs, 10 feet (3048 mm) from openings into the building, and 10 feet (3048 mm) above adjoining grade.~~

~~502.2.3~~ 502.2.4 Commercial Kitchen Ducts.
Commercial kitchens exhaust ducts shall terminate in accordance with Section 510.9 for Type I exhaust systems or Section 519.5 for Type II exhaust systems.

504.2 Independent Exhaust Systems.
Single or combined mechanical exhaust systems for environmental air shall be independent of other exhaust systems. Combined exhaust systems shall operate at negative pressure and shall terminate in accordance with Section 502.2.1. Clothes dryer exhaust systems shall be independent of all other exhaust systems except where permitted in Section 504.4.4.

504.3 Domestic ~~Range~~ Cooking Exhaust Equipment.
~~Duct used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces.~~ Domestic cooking exhaust equipment shall comply with the following requirements, as applicable:

(1) The fan for overhead range hoods and downdraft exhaust equipment not integral with the cooking appliance shall comply with UL 507.
(2) Overhead range hoods and downdraft exhaust equipment with integral fans shall comply with UL 507.
(3) Domestic cooking appliances with integral downdraft exhaust equipment shall comply with UL 858 or CSA/ANSI Z21.1/CSA 1.1.
(4) Microwave ovens with integral exhaust for installation over the cooking surface shall comply with UL 923.
(5) All domestic kitchen exhaust ducts used in conjunction with domestic range or cooktop hoods shall be constructed of metal and shall have smooth interior surfaces, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181A.
Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided the following conditions are met:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (150 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and grease tight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.
(6) Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

504.4.6 Multistory Exhausting of Dryers.
Each vertical riser shall be provided with a means for cleanout or access door located at the bottom of the main exhaust shaft for lint removal.

504.5 Heat ~~(Energy)~~ Recovery ~~Ventilators~~ Ventilation(HRV) and Energy Recovery Ventilation(ERV) Systems.
Heat ~~(energy)~~ recovery ventilators (HRV) and Energy recovery ventilators (ERV) shall be installed in accordance with their listings and comply with the appliance manufacturer's installation instructions. Non-ducted heat recovery ventilators shall comply with UL 1815. Ducted heat recovery ventilators shall comply with UL 1812. Heat ~~(energy)~~ recovery ventilator and energy recovery ventilator ducts shall comply with Chapter 6.

505.7.3 Smoke Control Systems.
Smoke control systems shall be designed in accordance with NFPA 92 and installed where required *by the California Building and the California Fire Code*. Smoke control systems shall be equipped with a control unit that complies with UL 864.

505.8 Product-Conveying Ducts Classification.
Product-conveying ducts shall be classified according to their use, as follows:

Class 1 - Ducts conveying non-abrasives, such as smoke, spray, mists, fogs, noncorrosive fumes and gases, light fine dusts, or powders.
Class 2 - Ducts conveying moderately abrasive particulate in light concentrations, such as sawdust and grain dust, and buffing and polishing dust.
Class 3 - Ducts conveying Class 2 materials in high concentrations and highly abrasive materials in low concentrations, such as manganese, steel chips, and coke.
505.8 Product-Conveying Ducts Classification.
Class 4 - Ducts conveying Class 3 materials in high concentrations and highly abrasive material in high concentrations, such as alumina, bauxite, iron silicate, sand, and slag.
Class 5 - Ducts conveying corrosives, such as acid vapors.

506.0 Product-Conveying Ducts.
506.6 Explosion Venting. Ducts conveying explosive dusts shall have explosion vents, openings protected by anti-flashback swing valves, or rupture diaphragms. Openings to relieve explosive forces shall be located outside the building. Where relief devices cannot provide sufficient pressure relief, ductwork shall be designed to withstand an internal pressure of not less than 100 pounds-force per square inch (psi) (689 kPa). Where a room or building contains a dust explosion hazard that is external to protected equipment, as defined in NFPA 654, such areas shall be provided with deflagration venting to a safe outside location.
Systems exhausting explosive mixtures shall be protected by an approved explosion relief system in accordance with NFPA 69.

506.9 Protection from Physical Damage.
Ducts and exhaust equipment installed in locations where they are subject to physical damage shall be protected by guards.

508.0 Types I Hoods.
508.4 Supports. Hoods shall be secured in place to resist lateral loads *[OSHPD 1, 1R, 2, 4 & 5] given in the California Building Code, Title 24, Part 2* by noncombustible supports. The supports shall be capable of supporting the expected weight of the hood and plus 800 pounds (362.9 kg).

508.5.1.4 Medium-Duty Cooking Appliances.
The minimum net airflow for hoods used for cooking appliances such as electric and gas hot-top ranges, gas open-burner ranges (with or without oven), electric and gas flat griddles, electric and gas double-sided griddles, electric and gas fryers (including open deep fat fryers, donut fryers, kettle fryers, tortilla chip fryers, and pressure fryers), electric and gas smokers, and electric and gas conveyor pizza ovens shall be in accordance with Table 508.5.1.4.

519.0 Type II Hood Exhaust System Requirements.

519.3 Type II Hood Exhaust System Net Airflow. The net airflow for Type II hoods shall be in accordance with Section 508.5.1.5 for light-duty cooking appliances. The net airflow for Type II hoods serving dishwashing appliances shall comply with Section 519.3.1.

519.7 Independent Exhaust Duct System. Single or combined Type II exhaust systems shall be independent of all other exhaust systems.

Chapter 6 Duct systems

602.2 Combustibles Within Ducts or Plenums.
…
(9) Plastic water distribution piping listed and labeled for use in plenums in accordance with UL 2846 as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet (1524 mm), and installed in accordance with its listing, shall be permitted.

602.3 Tall Wood(Mass Timber) Buildings.
Duct systems installed in tall wood (mass timber) buildings shall comply with the following:

(1) Be designed by a registered design professional in accordance with this code and the building code.

(2) Be designed to accommodate expansion, contraction, and differential movement between parts of a tall wood (mass timber) building in accordance with Section 316.2.

602.5.4 Fibrous Glass Duct.
Fibrous glass ducts, plenums, or fittings shall be constructed in accordance with SMACNA Fibrous Glass Duct Construction Standards or NAIMA Fibrous Glass Duct Construction Standards.

~~602.6~~ 602.7 Corridors.
Corridors shall not be used to convey air to or from rooms where the corridor is required to be of fire-resistive construction in accordance with the building code except where permitted by the building code. Corridors shall not serve as supply, return, exhaust, relief, or ventilation air ducts.

603.1.1 Pressure Classification.
The pressure classification of ducts shall be not less than the design operating pressure of the air distribution in which the duct is utilized. All ducts regardless of pressure classification(s) shall be sealed to Seal Class A.

603.1~~3.1~~6 Earthquake Loads.
Ducts located in structures that are installed in areas classified as seismic design categories ~~C, D, E or F *California Building Code or California Residential Code*~~ shall be restrained to resist displacement due to earthquake motion.

603.4.1.1 Flexible Ducts. [OSHPD 1, 2, 3, 4 & 5]
… Flexible duct is not permitted in corridors where fire or smoke dampers are omitted per CBC 717.5.4 and the duct is required to be constructed of steel not less than 0.019 inch (0.483 mm) in thickness.

603.9 Joints and Seams of Ducts.
Joints and seams for duct systems shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible, SMACNA Round Industrial Duct Construction Standards, or SMACNA Rectangular Industrial Duct Construction Standards, as applicable. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other means. All ducts shall be sealed to Seal Class A. Crimp joints for round ducts shall have a contact lap of not less than 1-1/2 inches (38 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint, or an equivalent fastening method.

605.1.2 Duct Coverings and Linings.
Insulation applied to the interior or exterior surface of ducts located in buildings, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50,where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C). Coverings shall not penetrate a fire-resistance-rated assembly. The duct coverings and linings shall be listed and labeled.

606.3 Ceiling Radiation Dampers.
Ceiling radiation dampers shall comply with UL 555C or shall be tested as part of a fire-resistance-rated floor-ceiling or roof-ceiling assembly in accordance with ASTM E119 or UL 263, and shall be installed in accordance with the manufacturer's installation instructions in the fire-resistive ceiling membrane of floor-ceiling and roof-ceiling assemblies where required by the building code. Fire dampers not meeting the temperature limitation of ceiling radiation dampers shall not be used as a substitute.

606.4 Combination Fire/Smoke Dampers.
Combination fire/smoke dampers shall comply with UL 555 and UL 555S and the requirements in Section 606.1 and Section 606.2.

606.4.1
When the automatic activation of a smoke damper or a combination smoke-fire damper occurs, the HVAC system serving such dampers shall immediately shut down.
Exceptions:
(1) HVAC systems that are part of an engineered smoke evacuation system.
(2) Where the automatic activation causes all the smoke dampers and combination smoke-fire dampers to close in the enclosed space having a common atmosphere where openings are required to be protected.
(3) Where analysis demonstrates shutoff would create a greater hazard. The HVAC system shall not be restarted again until all the dampers are reset and fully opened.

606.5 Corridor Dampers.
Corridor dampers shall comply with the requirements of combination fire/smoke dampers in Section 606.4.

606.6 Periodic Testing and Inspection.
Testing and inspection of dampers shall be in accordance with the following:
(1) Smoke dampers shall be tested in accordance with NFPA 105.
(2) Fire dampers shall be tested in accordance with NFPA 80.
(3) Combination fire/smoke dampers shall be tested in accordance with NFPA 80 and NFPA 105.

Chapter 8 Chimneys and vents

802.8 Through-the-Wall Vent Termination.

Through the-wall vent termination shall be in accordance with Section 802.8.1 through Section 802.8.3.

802.8.1 Clearance for Through-the-Wall Vent Termination. The clearance for through-the-wall direct vent and non-direct vent terminals shall be in accordance with Table 802.8.1 and Figure 802.8.1. Exception: The clearances in Table 802.8.1 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.1]

802.8 Through-the-Wall Vent Termination.

TABLE 802.8.1
THROUGH-THE-WALL DIRECT VENT TERMINATION CLEARANCES
[NFPA 54: TABLE 12.9.1]

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCES FOR DIRECT VENT TERMINALS	MINIMUM CLEARANCES FOR NON-DIRECT VENT TERMINALS
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	12 inches
B	Clearance to window or door that is openable	6 inches for Appliances ≤ 10 000 Btu/hr 9 inches for Appliances > 10 000 Btu/hrs ≤ 50 000 Btu/hr 12 inches for Appliances > 50 000 Btu/hrs ≤ 150 000 Btu/hr Appliances > 150 000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for non-direct vent terminals in row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to non-openable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to non-mechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for row B	
I	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
J	Clearance above paved sidewalk or paved driveway located on public property or other areas where condensate or vapor can cause a nuisance or hazard	7 feet and not located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
K	Clearance to underside of veranda, porch, deck, or balcony	12 inches where the area beneath the veranda, porch, deck, or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

For SI Units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW

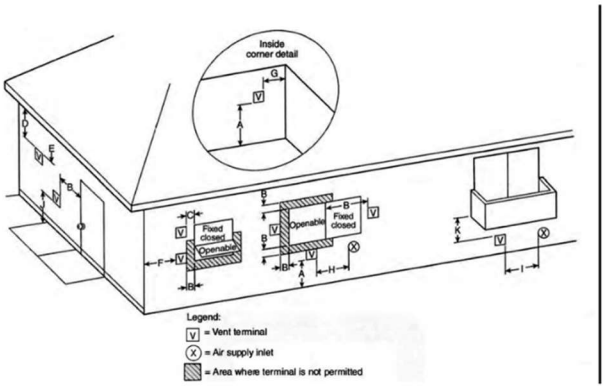


FIGURE 802.8.1
EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT VENT VENTING SYSTEMS

Chapter 9 Installation of Specific appliances

903.3 Packaged Terminal Air Conditioners.

Packaged terminal air conditioners and heat pumps shall comply with UL 484 or UL 60335-2-40, and shall be installed in accordance with the manufacturer's installation instructions.

904.1 Application.

Central heating furnaces and boilers shall be listed in accordance with the following:

- Under 400,000 Btu/hr
- Furnaces CSA/ANSI Z21.47/CSA 2.3.
- Low-pressure boilers ANSI Z21.13/CSA 4.9. [NFPA 54:10.3.1.1]
- Greater than 400,000 Btu/hr
- shall be listed or in accordance with Section 904.1(2)(a) and Section 904.1(2)(b). [NFPA 54:10.3.1.2]

925.6 Electric Radiant Heaters.
Electric radiant heaters shall comply with UL 2021 and installed in accordance with the manufacturer's installation instructions.
939.0 Sauna Heaters.

939.1 Electric Sauna Heaters. Sauna heaters shall be listed and labeled in accordance with UL 875 and shall be installed in accordance with the manufacturer's installation instructions.

Chapter 10 Boilers and Pressure Vessels

1003.4 Stack Dampers.
Stack dampers on boilers fired with oil or solid fuel shall not close off more than 80 percent of the stack area. where closed, except on automatic boilers with prepurge, automatic draft control, and interlock. Operative dampers shall not be placed within a stack, flue, or vent of a gas-fired boiler, except on an automatic boiler with prepurge, automatic draft control, and interlock.
Exception: Automatic boilers with prepurge, automatic draft control, and interlock.

1004.4 Minimum Capacity of Closed-Type Tank.
The minimum capacity for a gravity-type hot water system expansion tank shall be in accordance with Table 1004.4(1). The minimum capacity for a forced-type hot water system expansion tank shall be in accordance with Table 1004.4(2), or Equation 1004.4(1). Equation 1004.4 shall not be used for diaphragm-type expansion tanks. The minimum capacity for a diaphragm-type hot water system expansion tank shall be in accordance with Table 1004.4(2) or Equation 1004.4(2).

1005.2 Discharge Piping.
The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and provided with the following:

(1) Equal to Not less than the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) Discharge to a termination point that is readily visible.

1008.0 Low-Water Cutoff.

1008.1 General. Hot water boilers and steam boilers shall be installed with a low-water cutoff. A coil-type boiler or a water-tube boiler that requires forced circulation to prevent overheating of the coils or tubes shall be installed with a flow-sensing device in the outlet piping in lieu of the low-water cutoff. The low-water cutoff or the flow sensing device shall be installed so as to prevent damage to the boiler and to permit testing of the fuel-supply cutoff without draining the heating system. The low-water cutoff shall shut off the ~~combustion~~ energy source at a water level setpoint that is in accordance with the boiler manufacturer's instructions.

Chapter 11 Refrigeration

Table 1102.3

TABLE 1102.3
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES[7]
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME[1] (COMPOSITION FOR BLENDS)	SAFETY GROUP	OEL[2] (ppm)	RCL (lb/Mcf)	LFL[8] (lb/Mcf)
R-11	CCl_3F	Trichlorofluoromethane	A1	1000	0.39	—
R-12	CCl_2F_2	Dichlorodifluoromethane	A1	1000	5.6	—
R-12B1	$CBrClF_2$	Bromochlorodifluoromethane	—	—	—	—
R-13	$CClF_3$	Chlorotrifluoromethane	A1	1000	—	—
R-13B1	$CBrF_3$	Bromotrifluoromethane	A1	1000	—	—
R-13I1	CF_3I	Trifluoroiodomethane	A1	500	1.0	—
R-14	CF_4	Tetrafluoromethane (carbon tetrafluoride)	A1	1000	25	—
R-21	$CHCl_2F$	Dichlorofluoromethane	B1	—	—	—
R-22	$CHClF_2$	Chlorodifluoromethane	A1	1000	13	—
R-23	CHF_3	Trifluoromethane	A1	1000	7.3	—
R-30	CH_2Cl_2	Dichloromethane (methylene chloride)	B1	—	—	—
R-31	CH_2ClF	Chlorofluoromethane	—	—	—	—
R-32	CH_2F_2	Difluoromethane (methylene fluoride)	A2L	1000	4.8	19.1
R-40	CH_3Cl	[illegible]hloromethane (methyl chloride)	B2	[illegible]	[illegible]	[illegible]
R-1336	$CF_3CH=CH_2$	[illegible]-1,1,1,4,4,4-hexafluoro-2-butene	[illegible]	500	[illegible]	—
R-1336mzz(Z)	$CF_3CHCHCF_3$	Cis-1,1,1,4,4,4-hexaflouro-2-butene	A1	500	5.2	—

For SI units: 1 pound = 0.453 kg, 1 cubic foot = 0.0283 m^3

Notes:

1 The preferred chemical name is followed by the popular name in parenthesis.
2 The OELs are 8-hour TWAs; a "C" designation denotes a ceiling limit.
3 Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.
4 The exact composition of this azeotrope is in question and additional experimental studies are needed.
5 R-507, R-508, and R-509 are allowed alternative designations for R-507A, R-508A, and R-509A due to a change in designations after assignment of R-500 through R-509. Corresponding changes were not made for R-500 through R-506.
6 The RCL values for these refrigerant blends are approximated in the absence of adequate data for a component comprising less than 4 percent m/m of the blend and expected to have a small influence in an acute, accidental release.
7 In accordance with Section 1102.3, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 34 and is not capable of being modified.
8 LFL is based on WCF @ 73.4°F (23°C) unless otherwise noted.
9 WCFF LFL @ 140°F (60°C).
10 WCFF LFL @ 73.4°F (23°C).
11 WCF LFL @ 212°F (100°C).

1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

TABLE 1103.1.1
REFRIGERANT SAFETY GROUP CLASSIFICATIONS

Higher Flammability	A3	B3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No Flame Propagation	A1	B1
	Lower Toxicity	**Higher Toxicity**

1104.0 Requirements for Refrigerant and Refrigeration System Use.
1104.5 Flammable Refrigerants. The total of Group A2, B2, A3, and B3 refrigerants, other than Group A2L and B2L refrigerants shall not exceed 1100 pounds (498.9 kg) without approval by the Authority Having Jurisdiction. Institutional Occupancies shall comply with Section 1104.3. Machinery rooms required in accordance with Section 1106.0 based on flammability shall be constructed and maintained in accordance with Section 1106.2.1 through Section 1106.2.6 and Section1106.13 for Group A2L and B2L refrigerants.

1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section.[ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. stems using Group A2L refrigerants for human comfort applications shall comply with this section.[ASHRAE 15:7.6] Occupied spaces shall comply with the releasable charge limitations of the equipment listing and ASHRAE 15. Unoccupied spaces with refrigerant containing equipment, not including continuous piping or tubing, shall comply with the releasable charge limitations of the equipment listing or Section 1104.6.4. {ASHRAE15:7.6.1-7.6.1.2}

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer's instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.[ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detection Systems. Refrigerant detection systems shall be in accordance with the listing and ASHRAE 15.
1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detection system senses a refrigerant exceeding its setpoint, the following actions shall be taken:
(1) The supply air fan of the equipment shall activate with a minimum airflow rate specified by the manufacturer.
(2) Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detection

system has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.6(b).

Exception: The compressor operation shall not be turned off when the compressor operation reduces the leak rate or the total amount of released refrigerant to the indoor space.

(3) Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.

(4) Mitigation action required by the equipment listing shall be initiated. {ASHRAE 15:7.6.2.4}

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. [ASHRAE 15:7.6.3-7.6.3.3]

1104.6.4 Mechanical Ventilation. When the releasable charge of the refrigeration system exceeds the refrigerant concentration limit specified in Section 1104.6.1, the refrigerant charge and ventilation air flow shall be in accordance with the equipment listing and ASHRAE 15.

1104.6.5 Compressors and Pressure Vessels Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, the refrigerant charge shall be in accordance with the equipment listing and ASHRAE 15.

1104.6.6 Refrigerant Sensors. Refrigerant sensors required by Section 1104.6.2 shall meet the following requirements:

(1) Refrigerant sensors shall be evaluated by the testing laboratory as part of the equipment listing.

(2) Refrigerant sensors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating.

(a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant sensors shall be located within the listed equipment.

(b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant sensor shall be located in the equipment in accordance with the equipment listing. Additional remote refrigerant sensors shall be permitted within the occupied space when included as part of the equipment mitigation system according to manufacturer's instructions. {ASHRAE 15:7.6.5}

New Refrigerant Requirements

1104.8 Refrigerant Type and Purity.

1104.8.4 Mixing. Refrigerants with different refrigerant designations shall only be mixed in a system in accordance with the following:

(1) The addition of a second refrigerant is allowed by the equipment manufacturer and is in accordance with the manufacturer's instructions.

1104.9 Changing Refrigerants. Changes of refrigerant in an existing system to a refrigerant with a different refrigerant designation shall only be allowed where in accordance with Section 1104.9.1 through Section 1104.9.4. [ASHRAE 15:5.3]

1104.9.1 Approval.

1104.9.2 Procedures.

1104.9.3 Replacement Refrigerant of Same Classification.

1104.9.4 Replacement Refrigerant of Different Classification.

1106.0 Refrigeration Machinery Rooms.

~~**1106.2.5.2 Ventilation - Group A2L Refrigerants.** The emergency ventilation for A2L refrigerants shall have the capacity to provide mechanical exhaust at a rate determined in accordance with~~

~~**TABLE 1106.2.5.2 REQUIRED AIRFLOW FOR GROUP A2L REFRIGERANTS**~~

1106.11 Machinery Room, A2L and B2L. When required by Section 1106.1, machinery rooms shall comply with Section 1106.11.1 through Section 1106.11.6. [ASHRAE 15:8.13]

1106.11.1 Flame-Producing Device. There shall be no flame-producing device or hot surface over 1290°F (700°C) in the room, other than that used for maintenance or repair, unless installed in accordance with Section 1106.5. [ASHRAE 15:8.13.1]

1106.11.2 Communicating Spaces. Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors. [ASHRAE 15:8.13.2]

1106.0 Refrigeration Machinery Rooms.

1106.11.3 Noncombustible Construction. Walls, floor, and ceiling shall be tight and of noncombustible construction. Walls, floor, and ceiling separating the refrigerating machinery room from other occupied spaces shall be of at least one hour fire-resistive construction. [ASHRAE 15:8.13.3]

1106.11.4 Exterior Openings. Exterior openings, if present, shall not be under any fire escape or any open stairway. [ASHRAE 15:8.13.4]

1106.11.5 Pipe Penetrations. All pipes piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floor through which they pass. [ASHRAE 15:8.13.5]

1106.11.6 Machinery Room Designation. When any refrigerant of Groups A2, A3, B2, or B3 are used, the machinery room shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. When the only flammable refrigerants used are from Group A2L or B2L, the machinery room shall comply with both Section 1106.11.6.1 for ventilation and Section 1106.11.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. [ASHRAE 15:8.13.6]

1106.11.6.1 Mechanical Ventilation. The machinery room shall have a mechanical ventilation system in accordance with Section 1106.13.11. The mechanical ventilation system shall:

(1) Run continuously, and failure of the mechanical ventilation system actuates an alarm, or (2) Be activated by one or more refrigerant detectors, conforming to requirements of Section 1106.13.8. [ASHRAE 15:8.13.6.1]

1106.11.6.2 Detection System. Detection of refrigerant concentration that exceeds 25 percent of the LFL or the upper detection limit of the refrigerant detector, whichever is lower, shall automatically de-energize the following equipment in the machinery room:

(1) Refrigerant compressors
(2) Refrigerant pumps
(3) Normally closed automatic refrigerant valves
(4) Other unclassified electrical sources of ignition with apparent power rating greater than 1 kVA, where the apparent power is the product of the circuit voltage and current rating. [ASHRAE 15:8.13.6.2]

1106.11.7 Mechanical Equipment Control. Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door. [ASHRAE 15:8.13.7]

1106.11.8 Refrigerant Detectors. Each refrigerating machinery room in accordance with Section 1106.11 shall contain one or more refrigerant detectors in accordance with Section 1106.11.9. The detector(s) sensing element shall be located in areas where refrigerant from a leak will concentrate, with one or more set points that activate responses in accordance with Section 1106.11.10 for alarms and Section 1106.11.11 for mechanical ventilation. Multiport-type devices shall be prohibited. {ASHRAE 15:8.13.8}

1106.11.9 Refrigerant Detectors Requirements. Refrigerant detectors required by Section 1106.11 shall meet all of the following conditions:

(1) A refrigerant detector shall be capable of detecting each of the specific refrigerant designations in the machinery room.

(2) The refrigerant detector shall activate responses within a time not to exceed a limit specified in Section 1106.11.10 and Section 1106.11.11 after exposure to refrigerant concentration exceeding a limit value specified in Section 1106.11.10 and Section 1106.11.11.

(3) The refrigerant detector shall have a set point not greater than the applicable Occupational Exposure Limit (OEL) value in accordance with Table 1102.3. The applicable OEL value shall be the lowest OEL value for any refrigerant designation in the machinery room. For refrigerants that do not have an OEL value in Table 1102.3, use a value determined in accordance with the OEL as defined by ASHRAE 34 where approved by the Authority Having Jurisdiction.

(4) The refrigerant detector shall have a set point not more than the applicable Refrigerant Concentration Limit (RCL) value in accordance with Table 1102.3. The applicable RCL value shall be the lowest RCL value for any refrigerant designation in the machinery room. For refrigerants that do not have a RCL value in Table 1102.3, use a value determined in accordance with the RCL as defined by ASHRAE 34 where approved by the Authority Having Jurisdiction.

(5) The refrigerant detector shall provide a means for automatic self-testing and shall be in accordance with Section 1106.11.10.4. The refrigerant detector shall be tested during installation and annually thereafter in accordance with the fire code, or at an interval not exceeding the manufacturer's installation instructions, whichever is less. Testing shall verify compliance with the alarm set points and response times per Section 1106.11.10 and Section 1106.11.11. [ASHRAE 15:8.13.9]

1106.11.10 Alarms. Alarms required by Section 1106.11.8 shall comply with Section 1106.11.10.1 through Section 1106.11.10.4.

1106.11.10.1 Visual and Audio. The alarm shall have visual and audible annunciation inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room. [ASHRAE 15:8.13.10.1]

1106.11.10.2 Detector Activation. The refrigerant detector set points shall activate an alarmin accordance with the type of reset in Table 1106.11.10.2. Manual reset type alarms shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.10.2]

1106.11.10.3 Alarm Levels. Alarms set at levels other than Table 1106.11.10.2 (such as IDLH) and automatic reset alarms are permitted in addition to those required by Section 1106.11.10. The meaning of each alarm shall be clearly marked by signage near the annunciators. [ASHRAE 15:8.13.10.3]

TABLE 1106.11.10.2
REFRIGERANT DETECTOR SET POINTS, RESPONSE TIMES, ALARMS, AND VENTILATION LEVELS
[ASHRAE 15: TABLE 8-1]

LIMIT VALUE	RESPONSE TIME (seconds)	ALARM TYPE	ALARM RESET TYPE	VENTILATION RATE	VENTILATION RESET TYPE
Set point ≤ OEL	≤300	Trouble Alarm	Automatic	Level 1	Automatic
Set point ≤ RCL	≤15	Emergency Alarm	Manual	Level 2	Manual

1106.11.10.4 Emergency. In the event of a failure during a refrigerant detector self-test in accordance with Section 1106.11.9(5), a trouble alarm signal shall be transmitted to an approved monitored location. [ASHRAE 15:8.13.10.4]

1106.11.11 Mechanical Ventilation. Machinery rooms, in accordance with Section 1106.11, shall be vented to the outdoors, using mechanical ventilation in accordance with Section 1106.11.11.1, Section 1106.11.11.2, and Section 1106.11.11.3. [ASHRAE 15:8.13.11]

1106.11.11.1 Mechanical Ventilation Requirements. Mechanical ventilation referred to in Section 1106.11.11 shall be in accordance with all of the following:

(1) Include one or more power-driven fans capable of exhausting air from the machinery room;
multispeed fans shall be permitted.
(2) Electric motors driving fans shall not be placed inside ducts; fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.
(3) Include provision to supply make-up air to replace that being exhausted; ducts for supply to and exhaust from the machinery room shall serve no other area; the makeup air supply locations shall be positioned relative to the exhaust air locations to avoid short circuiting.
(4) Inlets to the exhaust ducts shall be located in an area where refrigerant from a leak will concentrate, in consideration of the location of the replacement supply air paths, refrigerating machines, and the density of the refrigerant relative to air.
(5) Inlets to exhaust ducts shall be within 1 foot (0.3 m) of the lowest point of the machinery room for refrigerants that are heavier than air and shall be within 1 foot (0.3 m) of the highest point for refrigerants that are lighter than air.
(6) The discharge of the exhaust air shall be to the outdoors in such a manner as not to cause a nuisance or danger. [ASHRAE 15:8.13.11.1]

1106.11.11.2 Level 1 Ventilation Rate. The refrigerating machinery room mechanical ventilation in Section 1106.11.11.1 shall exhaust at an airflow rate not less than shown in Table 1106.11.11.2. [ASHRAE 15:8.13.11.2]

TABLE 1106.11.11.2
LEVEL 1 VENTILATION RATE FOR CLASS 2L REFRIGERANTS
[ASHRAE 15: TABLE 8-2]

STATUS	AIRFLOW
Operated when occupied and operated when activated in accordance with Section 1106.11.9(3) and Table 1106.11.10.2	The greater of the following: (1) 0.5 ft^3/min per ft^3 of machinery room area, or (2) 20 ft^3/min per person
Operable when occupied	With or without mechanical cooling of the machinery room, the greater of: (1) The airflow rate required to not exceed a temperature rise of 18°F above inlet air temperature or (2) The airflow rate required to not exceed a maximum air temperature of 122°F in the machinery room.

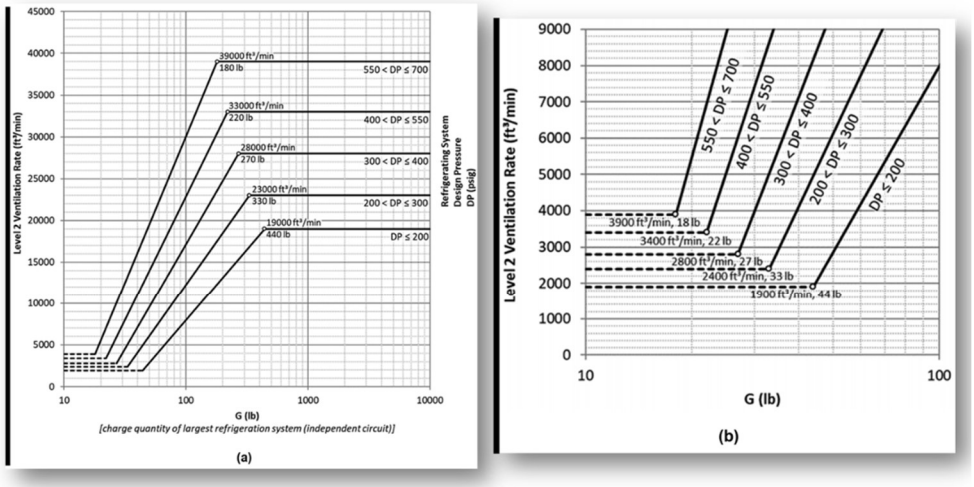
For SI units: °C = °F (5/9), 1 cubic foot = 0.0283 m^3, 1 cubic foot per minute = 0.0283 m^3/min, 1 cubic foot per minute = 0.4719 L/s

1106.11.11.3 Level 2 Ventilation. A part of the refrigerating machinery room mechanical ventilation referred to in Section 1106.11.11.1 shall exhaust an accumulation of refrigerant due to leaks or a rupture of a refrigerating system, or portion thereof, in the machinery room. The refrigerant detectors required in accordance with Section 1106.11.8 shall activate ventilation at a set point and response time in accordance with Table 1106.11.10.2, at an airflow rate not less than the value determined in accordance with Section 1106.11.11.4.

When multiple refrigerant designations are in the machinery room, evaluate the required airflow according to each refrigerating system, and the highest airflow quantity shall apply.

Ventilation reset shall be in accordance with the type of reset in Table 1106.11.10.2. Manual-type ventilation reset shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.11.3]

1106.11.11.4 Level 2 Ventilation Rate. When required by Section 1106.11.11.3, the total airflow for Level 2 ventilation shall be not less than the airflow rate determined by Figure 1106.11.11.4. [ASHRAE 15:8.13.11.4]



For SI Units: 1 pound = 0.453 kg, 1 cubic foot per minute = 0.47194 L/s, 1 pound-force per square inch = 6.8947 kPa

FIGURE 1106.11.11.4
LEVEL 2 VENTILATION RATE FOR CLASS 2L REFRIGERANTS
[ASHRAE 15: FIGURE 8-1]

1109.0 Refrigeration Piping, Containers, and Valves.

1109.1 Materials. Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, the lubricant, or their combination in the presence of air or moisture to a degree that poses a safety hazard. [ASHRAE 15:9.1.1] Refrigerant piping shall be metallic. Materials for refrigerant piping, tubing, and fittings shall comply with the applicable standards in Table 1109.1.

TABLE 1109.1
MATERIALS FOR REFRIGERANT PIPING, TUBING, AND FITTINGS

MATERIAL	STANDARDS	
	PIPING/TUBING	FITTINGS
Aluminum	ASTM B210, ASTM B491	ASTM B361
Copper/copper alloy	ASTM B42, ASTM B43, ASTM B68, ASTM B75, ASTM B88, ASTM B280, ASTM B302, ASTM B819, ASTM B1003	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.24, ASME B16.26, ASME B16.50
Steel	ASTM A53, ASTM A106, ASTM A254, ASTM A333, ASTM A334	ASTM A105, ASTM A181, ASTM A193, ASTM A234, ASTM A420, ASTM A707

1115.5 Nameplate.

Each self-contained system and each separate condensing unit, compressor, or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, design pressures, and refrigerant for which it is designed. The refrigerant shall be designated by the refrigerant number ("R-" number) as shown in Table 1102.3. {ASHRAE 15:9.15}

Heat pumps and electric cooling appliances shall bear a factory-applied nameplate in accordance with Section 307.3.

1127.0 Water Supply.

1127.1 General. Cooling towers, evaporative coolers and fluid coolers shall be provided with an approved water supply, sized for peak demand. The quality of water shall be provided in accordance with the equipment manufacturer's recommendations. The piping system and protection of the potable water supply system shall be installed in accordance with the plumbing code.

Chapter 12 Hydronics

1201.0 General.

1201.6 Heat Transfer Fluid Quality. Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

1201.6.1 Ethylene Glycol. Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

~~**1215.3**~~ **1201.10 Freeze Protection.** Hydronic systems and components shall be designed, installed, and protected from freezing. The percent of glycol by volume shall be determined based on the freezing point of the solution and type of mixture in accordance with Table 1201.10 or the manufacturer's specifications.

TABLE 1201.10
PERCENT GLYCOL MIXTURES

	FREEZING POINT, °F	
(% BY VOLUME)	ETHYLENE GLYCOL*	PROPYLENE GLYCOL
20	16	18
30	3	8
40	-12	-7
50	-35	-28

For SI units: °C = (°F-32)/1.8

Note:

* Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

1201.10.1 Antifreeze Requirements. Antifreeze shall be added to a closed hydronic system where one or more of the following conditions exists:

(1) System component(s) are exposed to freezing conditions.
(2) The hydronic system serves as a snow and ice melt system in accordance with Section 1220.0.
(3) Where required by the equipment manufacturer.
Exception: Antifreeze shall not be required where a system is continuously monitored or specifically designed not to require antifreeze, and is subject to freezing as a result of either of the following:
(1) Loss of electrical power.
(2) Loss of a fuel source.

1202.2 Chemical Injection.
~~Additives or chemicals shall be compatible with system components.~~ Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by ~~a reduced-pressure principle backflow prevention assembly listed or labeled in accordance with ASSE 1013~~ an air gap in accordance with ASME A112.1.2, an air gap fitting that complies with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly that complies with ASSE 1013. ~~Such additive or chemical shall be compatible with system components~~.

1204.0 Identification of Potable and Nonpotable Water Systems.
1204.7 Heat Transfer Fluid. Hydronic piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK." Each hydronic system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 1204.3.
Each outlet on the hydronic piping system shall be posted with black uppercase lettering as follows:
"CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."

1204.8 Identification of Chemical Additives. In systems where chemical additives are used, documentation including the following information shall be readily accessible and maintained onsite:
(1) Concentrations
(2) Maintenance requirements
(3) Maintenance log
(4) Material Safety Data Sheet (SDS)

1207.5 Heat Pumps.
Heat pumps shall comply with UL 1995 or UL 60335-2-40. Air source heat pumps shall also comply with AHRI 210/240. In addition, ground-source heat pumps shall comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

1210.0 Materials.
1210.4 Oxygen Diffusion Corrosion. PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier.
~~Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid.~~

1210.4.1 Vented Closed-Loop Systems. All components installed in a vented closed-loop system shall be constructed of non-ferrous or other corrosion resistant materials.

1210.4.2 Non-Oxygen Barrier Closed-Loop Systems. All components installed in a non-oxygen barrier system shall be constructed of non-ferrous or other corrosion resistant materials.

1211.0 Joints and Connections.
… Joints used underground shall be of an approved type for buried applications in accordance with Section 1221.2.3. 1211.2 Pipe Bends. Pipe bends shall be formed in accordance with Section 1211.2.1 for PEX or Section 1211.2.2 for PE.

TABLE 1211.2.2
MINIMUM BEND RADIUS FOR PE PIPE INSTALLED IN OPEN CUT TRENCH

DIMENSION RATIO (DR)	MINIMUM COLD BEND RADIUS
7	20 x Pipe OD
7.3	
9	
11	25 x Pipe OD
13.5	
17	27 x Pipe OD
21	
26	34 x Pipe OD
32.5	42 x Pipe OD
41	52 x Pipe OD
Fitting or flange present in bend	100 x Pipe OD

1211.2.1 Crosslinked Polyethylene (PEX) Tubing. Crosslinked polyethylene (PEX) tubing bends shall have a bend radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer's installation instructions.
1211.2.2 Polyethylene (PE) Plastic Pipe/Tubing. Polyethylene pipe and tubing bends shall have a bend radius in accordance with Table 1211.2.2. When a fitting or flange connection is present in the pipe bend, the minimum bend radius shall be one hundred times the pipe outside diameter (OD) for a distance of five times the pipe diameter on either side of the fitting location.
1211.2.3 Polyethylene of Raised Temperature (PERT) Tubing. Polyethylene of raised temperature (PE-RT) tubing bends shall have a bend radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer's installation instructions.

1211.15 Stainless Steel Pipe and Joints. Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 1211.15.1 or Section 1211.15.2.

1211.15.1 Mechanical Joints. Mechanical joints shall be designed for their intended use. Such joints shall include compression, flanged, grooved, press-connect, and threaded.

1211.15.2 Welded Joints. Welded joints shall be either fusion or resistance welded based on the selection of the base metal. The chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping material.

1212.12 District Energy and Central Utility Systems.
Isolation valves shall be installed on the building supply and return of a district energy or central utility system.

1214.0 Pressure and Flow Controls.
1214.4 Automatic Makeup Fluid. Automatic makeup fluid shall be in accordance with Section 1214.4.1 for potable water makeup fluid or Section 1214.4.2 for nonpotable makeup fluid.

1214.0 Pressure and Flow Controls.
1214.4.1 Potable Makeup Fluid.
Where a potable water ~~an~~ automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed-loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location. A potable water makeup supply shall be decoupled and provided with a monitoring system. A potable water makeup supply shall not be required for systems which use antifreeze as the heat transfer fluid. On systems using only water as a heat transfer medium, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 1202.0 to prevent contamination due to backflow.

1214.4.2 Nonpotable Makeup Fluid. Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems.
On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit or glycol feeder shall be required.

1217.10.1 California Energy Code Pipe Insulation Requirements.
See California Energy Code Sections 150.0(j)2 and 120.3(c) for pipe insulation requirements based on fluid temperature and pipe diameter – where California Energy Code Table 120.3-A-1 or Table 120.3-A-2 specifies insulation greater than R- 12, the higher value is required.

1220.4.3 Multizone Systems.
In multizone systems, each zone shall have a tag or label securely affixed to the manifold to indicate the length of the loops and the area(s) served.

1221.0 Piping Installation.
1221.6 Hydronic Fluid Disposal. Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with Environmental Protection Agency (EPA), the Department of Health, and as required by the Authority Having Jurisdiction.

Chapter 13 Furl Gas Piping

~~**1308.2 Provision for Location of Point of Delivery.**~~
~~The location of the point of delivery shall be acceptable to the serving gas supplier. [NFPA 54:5.2]~~

1308.23 Interconnections ~~Between Gas Piping Systems~~ Supplying Separate Users.
Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping system shall not be interconnected on the outlet side of the meter or service regulators. [NFPA 54:5.~~3~~2.1]

1308.2~~3~~.1 Interconnections for Standby Fuels.

1308.3.2 Sizing Methods.
Gas piping shall be sized in accordance with one of the following:

(1) Pipe Sizing tables or sizing equations in this chapter.
(2) Other approved engineering methods
(3) Sizing tables included in a listed piping system manufacturer's installation instructions [NFPA 54:5.34.3.]

1308.3.3 Allowable Pressure Drop.
The design pressure loss in ~~any~~a piping system ~~under maximum probable flow conditions,~~ from the point of delivery to the inlet connection of ~~the appliance~~,all appliances served shall be such that the supply pressure at ~~the~~each appliance inlet is greater than or equal to the minimum pressure required by the appliance. [NFPA 54:5.3.4]

1308.4.2 Metallic Pipe.
Cast-iron pipe shall not be used. [NFPA 54:5.6.2.1] Metallic pipe shall be in accordance with the Section 1308.6.3.1 through Section 1308.6.3.4.

1308.4.4.1 Regulator Vent Piping.
Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651, Schedule 40 and 80 Rigid PVC Conduit and Fittings. PVC vent piping shall not be installed indoors. [NFPA 54:5.56.4.2]

1308.4.6.3 Thread Joint ~~Compounds~~ Sealing.
Thread joint sealing materials compounds shall be non-hardening and shall be resistant to the action of LP-Gas or to any other chemical constituents of the gases to be conducted through the piping. [NFPA 54:5.56.6.4.3]

1308.4.7.2 Copper Tubing Joints.
Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32 CSA LC 4, Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54:5.56.7.2]

1308.4.7.3 Stainless Steel Tubing Joints.
Stainless steel joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point in excess of 1000°F (538°C), or assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32 CSA LC 4, Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Brazing alloys and fluxes shall be recommended by the manufacturer for use on stainless steel alloys. [NFPA 54:5. 5.7.3]

1308.4.8.2 Heat Fusion Joint.
Heat-fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Heat fusion fittings shall be marked “ASTM D2513.” [NFPA 54:5.6.8(2)]

1308.6.1.1 ~~Subject to~~ Protection from Damage
Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or where they will be subject to excessive corrosion or vibration. [NFPA 54:5.67.2.2]

~~**1308.5.1.1 Other Materials.**~~
~~Material not covered by the standards specifications listed herein shall meet the following criteria:~~

~~(1) Be investigated and tested to determine that it is safe and suitable for the proposed service.~~
~~(2) Be recommended for that service by the manufacturer.~~
~~(3) Be acceptable to the Authority Having Jurisdiction.~~
~~[NFPA 54:5.6.1.3]~~

1308.6.4 Regulator Vents.
Regulator vents shall be in accordance with Section 1308.14. [NFPA 54:5.7.5]

1308.6.5 Identification. Line pressure regulators at multiple regulator installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied. [NFPA 54:5.87.76]

~~**1308.8.5 Venting of Gas Appliance Pressure Regulators.**~~
~~For venting of gas appliance pressure regulators see Section 507.21. [NFPA 54:5.8.5.2]~~
~~**1308.8.6 Bypass Piping.**~~
~~Valved and regulated bypasses shall be permitted to be placed around gas line pressure regulators where continuity of service is imperative. [NFPA 54:5.8.6]~~

1308.12 Shutoff Valves.
Shutoff valves shall be selected in accordance with Table 1308.13. ~~approved and shall be selected giving consideration to pressure drop, service involved, emergency use, and reliability of operation.~~ Shutoff valves of size 1 inch (25 mm) National Pipe Thread and smaller shall be listed and labeled. Where used outdoors, such use shall be in accordance with the manufacturer's recommendation. [NFPA 54:5.112]

TABLE 1308.12
MANUAL GAS VALVE STANDARDS
[NFPA 54: TABLE 5.11]

SHUTOFF VALVE APPLICATION	STANDARDS
Appliance shutoff valve up to ½ psi	CSA/ANSI Z21.15/CSA 9.1
	ASME B16.44
	ASME B16.33 marked 125 G
	CSA/ANSI LC 4/CSA 6.32
Valve up to ½ psi	ASME B16.44
	ASME B16.33 marked 125 G
	CSA/ANSI LC 4/CSA 6.32
Valve up to 2 psi	ASME B16.44 labeled 2G
	ASME B16.33 marked 125 G
	CSA/ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 labeled 2G or labeled 5G
	CSA/ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 5 psi	ASME B16.44 labeled 5G
	ASME B16.33
	CSA/ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G
	CSA/ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 125 psi	ASME B16.33 marked 125 G
	CSA/ANSI LC 4/CSA 6.32 with ASME B16.33 marked 125 G

For SI Units: 1 pound-force per square inch = 6.8947 kPa

1308.14 Pressure Regulator ~~Vents~~ and Pressure Control Venting ~~of Line Pressure Regulators~~.
The venting of the atmospheric side of diaphragms in line pressure regulators, gas appliance regulators, and gas pressure limit controls shall be in accordance with all of the following:
(1) An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. For devices other than appliance regulators, vents are not required to be independent where the vents arc connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved.

Exception no. 1: A regulator and vent limiting means combination listed as complying with ANSI Z21.80/CSA 6.22 ~~CSA Z21.80~~, Line Pressure Regulators, shall not be required ~~permitted~~ to be ~~used without a~~ vented to the outdoors.

Exception no. 2: A listed gas appliance regulator factory equipped with a vent limiting device is not required to be vented to the outdoors.

(2) Materials for vent piping shall be in accordance with Section 1308.6 through Section 1308.6.13.5.
(3) The vent terminus shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
(4) Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.
(5) (3) The regulator Vents shall terminate not less at least 3 feet (914 mm) from a possible source of ignition.
(6) At locations where a vent termination could regulators might be submerged during floods or snow accumulations, an special antiflood-type breather vent fitting shall be installed, or the vent termination line shall be located extended above the height of the expected flood waters snow.
(7) (5) A regulator shall not be vented to the appliance flue or exhaust system Vent piping from pressure regulators and gas pressure controls shall be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve. [NFPA 54:14]

1310.1.5 Piping through Foundation Wall.
Piping through a foundation wall shall comply with all f the following:

(1) Underground piping, where installed through the outer foundation or basement wall of a building, shall be encased in a protective sleeve or protected by an approved device or method.
(2) The space between the gas piping and the sleeve and between the sleeve and the wall shall be sealed to prevent entry of gas and water.
(3) Sealing materials shall be compatible with the piping and sleeve. [NFPA 54:7.1.5]

1310.3 Installation of Aboveground Piping.
Piping installed aboveground shall comply with all of the following:

(1) Piping shall be securely supported and located where it will be protected from physical damage.
(2) Where passing through an exterior wall, the piping shall also be protected from corrosion by coating or wrapping with an inert material approved for such applications.
(3) The piping shall be sealed around its circumference at the point of the exterior penetration to prevent the entry of water, insects, and rodents.
(4) Where piping is encased in a protective pipe sleeve, the annular spaces between the gas piping and the sleeve and between the sleeve and the wall opening shall be sealed. [NFPA 54:7.2.1]
(5) Piping installed outdoors shall be elevated not less than 3-1/2 in. (89 mm) above the ground.

(6) Sealing materials shall be compatible with the piping and sleeve. [NFPA 54:7.2.1]

1310.3.5.3 Piping on Roofs Tops.
Gas piping installed on the roof surfaces shall be ~~elevated above the roof surface and shall be~~ supported in accordance with Table 1310.3.5.1. Gas piping shall be elevated not less than 3½ inches (89 mm) above the roof surface. [NFPA 54:7.2.6.4.1, 7.2.6.4.2] [NFPA 54:7.2.6.4.1]

1310.6Maximum Operating Pressure in Buildings.
The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

(1) The piping joints are welded or brazed.
(2) The piping is joined by fittings listed to ANSI LC 4/CSA 6.3, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems,* and installed according to the manufacturer's installation instructions.
(3) The piping joints are flanged and all pipe-to-flange connections are made by welding or brazing.
(4) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
(5) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
    (a) Industrial processing or heating
    (b) Research
    (c) Warehousing
    (d) Boiler or mechanical rooms
(6) The piping is a temporary installation for buildings under construction.
1308.45 Maximum Operating Pressure in Buildings.
(7) The piping serves appliances or equipment used for agricultural purposes.
(8) The piping system is an LP-Gas piping system with an operating pressure greater than 20 psi (138 kPa) and complies with NFPA 58. [NFPA 54:5.45.4]

1310.6.1 LP-Gas Systems Operating Below -5°F (-21°C).
LP-Gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-Gas or to prevent LP-Gas vapor from condensing back into a liquid. [NFPA 54:5.45.5]

1310.11.1 Accessibility of Gas Valves ~~Controlling Multiple Systems~~.
System ~~Main gas~~ shutoff valves ~~controlling several gas piping systems~~ shall be readily accessible for operation and installed so as to be protected from physical damage. ~~They~~ System shutoff values shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified. [NFPA 54:7.8.1.1]

1310.11.4 System Shutoff Valves.
Where a system shutoff valve is installed, the valve shall comply with Section 1308.13. [NFPA 54:7.8.4]

1312.1 Connecting Appliances and Equipment.
Appliances and equipment shall be connected to the building piping in compliance with Section 1312.6 through Section 1312.8 by one of the following:

(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A connector for gas appliances listed ~~connector~~ in accordance ~~compliance~~ with ANSI Z21.24/CSA 6.10, Connectors for Gas Appliances. ~~CSA Z21.24~~. The connector shall be used in accordance with the manufacturer's installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A ~~listed~~ connector for outdoor gas appliances and manufactured homes listed in accordance with ANSI Z21.75/CSA 6.27, Connectors for Outdoor Gas Appliances and Manufactured Homes ~~in compliance with CSA Z21.75~~. Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer's installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with Section 1312.3.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1312.4. [NFPA 54:9.6.13]

1312.1.1 Protection of Connectors.
Connectors and tubing addressed in Sections Section 1312.1(2), Section 1312.1(3), Section 1312.1(4), Section 1312.1(5), and Section 1312.1(6) shall be installed to be protected against physical and thermal damage. Aluminum alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation as detergents, sewage, or water other than rainwater. Materials addressed in Section 1312.1(2), Section 1312.1(3), Section 1312.1(4), Section 1312.1(5), and Section 1312.1(6) shall not be installed through an opening in an appliance housing, cabinet, or casing, unless the tubing or connector is protected against damage. [NFPA 54:9.6.1.2]

Chapter 14 Process Piping

1406.0 Pipe, Tubing, and Fittings.

1406.3.3 Gas-Detection System. Where hazardous production material gas is used or dispensed and the physiological warning properties of the gas are at a higher level than the accepted permissible exposure limit (PEL) of the gas, a continuous gas-monitoring system shall be provided to detect the presence of the short-term hazard condition. Where dispensing occurs and flammable gases or vapors are capable of being present in quantities in excess of 25 percent of the lower explosive limit (LEL), a continuous gas-monitoring system shall be connected to the emergency control station. The maximum permitted time-weighted average exposures to be utilized shall be as published in 29CFR 1910.1000.

~~Appendix F~~ Chapter 17 Geothermal Energy Systems and Ambient Temperature Loops

1701.0 General.

1701.1 Applicability.

Part I of this ~~appendix~~ chapter shall apply to all geothermal energy systems such as, but not limited to, building systems coupled with a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well). The regulations of this ~~appendix~~ chapter shall govern the construction, location and installation of geothermal energy systems. ~~Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section F 104.4 and Chapter 12. …~~

1701.1 Applicability.

1701.1.3 Indoor Piping. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 1704.4 and Chapter 12. Such materials shall be rated for the operating temperature and pressure of the system and shall be compatible with the type of transfer medium.

1701.11 Heat Transfer Fluid. The heat transfer fluid shall be compatible with the makeup ~~water~~ fluid supplied to the system.

1701.11.1 (N/A) 1701.11.1 Water Quality. The makeup water quality within the closed loop ground source heat pump system shall be in accordance with IAPMO/ANSI H1001.1, ANSI/CSA/IGSHPA C448, or Table 1701.11.1. The quality of potable water shall be in accordance with the Authority Having Jurisdiction.

1701.11.2 (N/A) 1701.11.2 Compatibility. System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and approved for compatibility.

TABLE 1701.11.1
WATER QUALITY[1]

PARAMETER	ACCEPTABLE RANGE
Ammonium	< 2 ppm
Chlorides[2]	< 125 ppm
(Free CO_2)[3]	< 50 ppm
pH	7.0 – 8.5
Sulphates	< 125 ppm
TDS	10 – 1000 ppm
Total Hardness	< 150 ppm

Notes:
1. Where chemical additives are used, the acceptable ranges provided shall be in accordance with the equipment manufacturer's specifications, or this table, whichever is more stringent.
2. The provided acceptable range for chlorides is dependent upon the system heat exchanger and piping materials. See the manufacturer's specifications for equipment and materials used.
3. The limit provided pertains to makeup water.

Part V – Geothermal Ambient Temperature Loops (ATL)

1716.0 Ambient Temperature Loop (ATL) Distributed Energy Systems.

1716.1 General. An Ambient Temperature Loop (ATL) distributed energy system shall be installed in accordance with Section 1716.2 through Section 1716.6.2 and Section 1717.0. ATL systems shall comply with Part I through Part IV of this chapter, as applicable.

1716.1.1 Fourth Generation(4G) System Configuration. A fourth-generation system configuration shall be a district geothermal energy system distributing hot water, cold water, or both to the conditioned space or building for a specific use. Where a geothermal energy source is used, such system shall comply with Part I through Part IV of this chapter, Chapter 11, and Chapter 12.

1716.1.2 Fifth Generation(5G) System Configurations. An advanced Ambient Temperature Loop (ATL) System or fifth generation (5G) ATL system shall also be capable of interacting with the electric utility system as well as other utility systems and systems components.

The system components shall include, but not limited to, the following:

(1) Thermally diverse buildings with independent hydronic systems
(2) Circulation loop
(3) Global control system
(4) Segment isolation capability

The system components may include, but not limited to, the following:

(1) Electric grid-interactive enabled buildings
(2) Hybrid components
(3) Other renewable systems

1716.2 Permitting. Permits required for the installation and application of an ATL distributed energy system shall be obtained as required by the Authority Having Jurisdiction.

1716.3 (N/A) 1716.3 Ambient Loop Temperature Range. The operating loop temperature range of an ambient temperature loop (ATL) system shall be not less than the freeze point of the circulating fluid and not more than the maximum temperature as required by the manufacturer's installation instructions for the attached heat pump equipment in accordance with Section 1716.3.1 and Section 1716.3.2. The ATL system shall use treated water as the heat transfer medium.
Part V – Geothermal Ambient Temperature Loops (ATL)

1716.3.1 ATL Operating Temperature. For equipment listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be not less than 7°F (4°C) above the freeze point of the transport fluid and 10°F (6°C) below the (collective) heat pump lowest maximum inlet supply temperature as recommended by the manufacturer's instructions.
Exception: Equipment that is not listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2. The controlled temperature range of the ambient closed loop shall be in accordance with Section 1716.3.2 for minimum and maximum temperatures.
Part V – Geothermal Ambient Temperature Loops (ATL)

1716.3.2 ATL Operating Temperature Range for Mixed Equipment Certifications. The source inlet temperature range of any attached equipment shall govern the design operating temperature range. Such equipment shall be identified in the design documentation. In any case the most restrictive minimum and maximum inlet supply temperatures, as recommended by the manufacturer's instructions, shall determine the system operating temperature range.

1716.4 Shutoff Valve. An automatic shutoff valve shall be provided for each individual building or facility transferring energy to or from an ATL distribution system. The automatic shutoff valve shall automatically shutoff upon operating command.

1716.4.1 Shutoff Valve Operation. The operation of the automatic shutoff valve shall be in accordance with the system operating procedures. Where the operation of a shutoff valve was due to an emergency response, an auxiliary heating or cooling methodology shall be provided in accordance with Section 1717.1.2.

1716.5 Bypass. The ATL distributed energy system shall be provided with bypass path(s) to reroute the circulating fluid when necessary.

1716.6 Metering. Where meters are required by the system design, meter(s) shall be located as specified by the manufacturer on each consumptive or supply source and the range of the metering shall be appropriate to the thermal properties and flow rate(s) of the transport fluid.

1716.6.1 Sub-Metering System Specification. The entire energy measurement system shall be provided with a sub-metering system. The metering system shall be calibrated and shall consist of a flow meter, temperature sensors, temperature thermowells, or other required mechanical installation metering. The sub-meter traceable calibration shall comply with the National Institute of Standards Technology (NIST) traceable calibration program or in accordance with the Authority Having Jurisdiction and shall be provided with an ATL distributed energy system.

1716.6.2 BTU/Thermal Meters. Where used, the Btu/thermal meter shall be bidirectional and shall provide the following information via digital or analog display:

(1) LCD, and via serial network communications.
(2) Total energy.
(3) Energy rate.
(4) Total flow.
(5) Flow rate.
(6) Supply temperature.
(7) Return temperature.

Each Btu/thermal meter shall be factory programmed for its specific application and shall be reprogrammable to adjust for specific site conditions.

1716.6.3 Flow Meter. Where used, the flow meter shall be provided with the following information via digital or analog display:

(1) LCD, and via serial network communications.
(2) Instantaneous fluid rate.
(3) Cumulative fluid flow volume.

1717.0 ATL Distributed Energy Systems Design Requirements.

1717.1 Thermal Resources. The ambient temperature loop shall be permitted to connect to a thermal resource(s). Such resources may be an alternative energy source and sink, such as but not limited to solar photovoltaic (PV), solar thermal, combined heat power (CHP), and phase change thermal storage. These systems shall be installed and comply with the respective system requirements. ATL distributed energy systems coupled with solar thermal systems shall comply with the Uniform, Solar, Hydronics and Geothermal Code (USHGC) or equivalent. ATL systems coupled with a solar PV system shall comply with the USHGC or NFPA 70, or equivalent. These systems shall optimize the use of the equipment and energy based on the system design intent.

1717.1.1 System Performance. The System Coefficient of Performance (SCOP) of the system shall take the net COP of each individual members in the district. The SCOP shall be provided by the designer and included in the system design documents.

1717.1.2 Emergency Response. An auxiliary heating or cooling methodology shall be provided with the ATL controls and shall be adequate to provide temporary service in the absence of an ATL energy transfer. Emergency source/sink measures such as but not limited to control subroutines that move energy between spaces in the building, use of locally connected ground source assets, combined heat and power (CHP), conventional equipment, other renewables systems may be used.

1717.2 District Load Profiles. The district load profile of an ambient temperature loop (ATL) distributed energy system shall be identified and shall be included in the basis-of-design (BOD).

1717.2.1 System Asset Identification. System assets shall be listed and included in the system design. The system asset shall include, but not be limited to, the following:

(1) Building type and quantity.
(2) Natural or constructed sources and sinks such as ground water, boreholes, etc.
(3) Other renewable assets.
(4) Wasted heat recovery.
(5) Potable and non-potable water or fluid sources.
(6) Conventional assets such as boilers and cooling towers.
(7) Other Geo Micro District or thermal highway.

Chapter 18 ~~17~~ Referenced Standards

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