

**California Mechanical Code
(Part 4, Title 24, California Code of Regulations)**

February 1, 2009 Supplement

**PLEASE NOTE: The date of the Supplement is for identification purposes only.
See the History Note Appendix for the adoption and effective dates of the provisions.**

It is suggested that the section number as well as the page number be checked when inserting this material and removing the superseded material. In case of doubt, rely on the section numbers rather than the page numbers since the section numbers must run consecutively.

It is further suggested that the superseded material be retained with this revision record sheet so that the prior wording of any section can be easily ascertained.

Please keep the removed pages with this revision for future reference.

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2007 California Code of Regulations Title 24

California Agency Information Contact List

California Energy Commission

Energy Hotline(800) 772-3300
Building Efficiency Standards
Appliance Efficiency Standards
Compliance Manual/Forms

California State Lands Commission

Marine Oil Terminals(562) 499-6317

California State Library

Construction Standards(916) 445-9604

Corrections Standards Authority

Local Adult Jail Standards(916) 324-1914
Local Juvenile Facility Standards ... (916) 324-1914

Department of Consumer Affairs – Acupuncture Board

Office Standards(916) 445-3021

Department of Consumer Affairs – Board of Pharmacy

Pharmacy Standards(916) 574-7900

Department of Consumer Affairs – Bureau of Barbering and Cosmetology

Barber and Beauty Shop and
College Standards(916) 952-5210

Department of Consumer Affairs – Bureau of Home Furnishings and Thermal Insulation

Insulation Testing Standards(916) 574-2041

Department of Consumer Affairs – Structural Pest Control Board

Structural Standards(800) 737-8188

Department of Consumer Affairs – Veterinary Medical Board

Veterinary Hospital Standards ... (916) 263-2610

Department of Food and Agriculture

Meat & Poultry Packing Plant
Standards(916) 654-0509
Dairy Standards(916) 654-0773

Department of Health Services

Organized Camps Standards(916) 449-5661
Public Swimming Pools
Standards(916) 449-5661
Asbestos Standards(510) 620-2874

Department of Housing and Community Development

Residential – Hotels, Motels, Apartments,
Single-Family Dwellings(916) 445-9471
Permanent Structures in Mobilehome and
Special Occupancy Parks(916) 445-9471
Factory-Built Housing, Manufactured
Housing and Commercial Modular .(916) 445-3338
Mobile Homes – Permits & Inspections
Northern Region(916) 255-2501
Southern Region(951) 782-4420
Employee Housing Standards(916) 445-9471

Department of Water Resources

Gray Water Installations Standards .(916) 651-9667

Division of the State Architect – Access Compliance

Access Compliance Standards(916) 445-8100

Division of the State Architect – Structural Safety

Public Schools Standards(916) 445-8100
Essential Services Building
Standards(916) 445-8100

Division of the State Architect – State Historical Building Safety Board

Alternative Building Standards ... (916) 445-8100

Office of Statewide Health Planning and Development

Hospital Standards(916) 440-8409
Skilled Nursing Facility Standards .(916) 440-8409
Clinic Standards(916) 440-8409

Office of the State Fire Marshal

Code Development and Analysis ..(916) 445-8200
Fire Safety Standards(916) 445-8200
Fireplace Standards(916) 445-8200
Day Care Centers Standards(916) 445-8200
Exit Standards(916) 445-8200

UMC FOREWORD

Not Adopted by The State of California

The *Uniform Mechanical Code*[®] (UMC[®]) provides complete requirements for the installation and maintenance of heating, ventilating, cooling, and refrigeration systems, while at the same time allowing latitude for innovation and new technologies.

This code was first published in 1967. With the publication of the 2003 edition of the *Uniform Mechanical Code*[®], another significant milestone was reached. For the first time in the history of the United States, a mechanical code was developed through a true consensus process. The 2006 edition represents the most current approaches in the mechanical field and is the second edition developed under the ANSI Consensus process. Contributions to the content of this code were made by every segment of the built industry, including such diverse interests as consumers, enforcing authorities, installers/maintainers, insurance, labor, manufacturers, research/standards/testing laboratories, special experts, and users.

The public at large is encouraged and invited to participate in IAPMO's open consensus code development process. This code is updated every three years. A code development timeline and other relevant information is available at IAPMO's website at www.iapmo.org.

The *Uniform Mechanical Code*[®] is dedicated to all those who, in working to achieve "the ultimate mechanical code," have unselfishly devoted their time, effort, and personal funds to create and maintain this, the finest mechanical code in existence today.

The 2006 *Uniform Mechanical Code*[®] is supported by the American Society of Sanitary Engineering (ASSE), Mechanical Contractors Association of America (MCAA), Plumbing-Heating-Cooling Contractors National Association (PHCC-NA), the United Association (UA), and the World Plumbing Council (WPC). The presence of these logos, while reflecting support, does not imply any ownership of the copyright to the UMC which is held exclusively by IAPMO. Further, the logos of these associations indicates the support of IAPMO's open, consensus process being used to develop IAPMO's codes and standards.

The addresses of the organizations are as follows:

ASSE – 901 Canterbury Road, Suite A • Westlake, Ohio 44145-7201 • (440) 835-3040
MCAA – 1385 Piccard Drive • Rockville, Maryland 20850 • (301) 869-5800
PHCC-NA – PO Box 6808 • Falls Church, Virginia 22046 • (800) 533-7694
UA – 901 Massachusetts Avenue NW • Washington, DC 20001 • (202) 628-5823
WPC – WPC Secretary • c/o The Institute of Plumbing • 64 Station Lane • Hornchurch Essex
RM12 6NB • United Kingdom • +44 17-08-47-27-91

Code changes made to the original amalgamated code are marked in the margins as follows.

← An arrow denotes a deletion | A vertical line denotes a change

CHAPTER 3 – GENERAL REQUIREMENTS

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X					X						
Adopt Entire Chapter as amended (amended sections listed below)			X	X	X			X	X	X	X		
Adopt only those sections that are listed below													
Article/Section	Codes												
304.2 and Exc. 2	CA							X	X	X	X		
304.6	CA		X										
304.7	CA			X	X								
313.0	CA							X	X		X		
314.1	CA							X			X		
314.2	CA								X		X		
315.1	CA							X			X		
315.2	CA								X		X		
315.3	CA									X			
316.0	CA							X	X	X	X		
Table 315	CA							X	X	X	X		

CHAPTER 4 – VENTILATION AIR SUPPLY

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter				X	X		X						
Adopt Entire Chapter as amended (amended sections listed below)		X	X										
Adopt only those sections that are listed below								X	X	X	X		
Article/Section	Codes												
401.0	CA		X					X	X	X	X		
402.0	CA							X	X	X	X		
402.1	CA	X						X	X	X	X		
403.0	CA							X	X	X	X		
404.0	UMC							X	X	X	X		
405.0	CA							X	X	X	X		
407.0	CA							X	X	X	X		
408.0	CA							X	X	X	X		
409.0	CA							X	X	X	X		
410.0	CA							X	X	X	X		
411.0	CA							X	X	X	X		
412.0	CA							X	X	X	X		
413.0	CA							X	X	X	X		
414.0	CA							X	X	X	X		
415.0	CA							X	X	X	X		
416.0	CA							X	X	X	X		
416.3	CA							X	X	X	X		
417.0	CA							X	X	X	X		
418.0	CA							X	X	X	X		
Table 4-1, Note	CA	X											
Table 4-A	CA							X	X	X	X		
Table 4-B	CA							X		X			
Table 4-C	CA								X		X		

CHAPTER 5 – EXHAUST SYSTEMS

Adopting Agency		BSC	SFM	HCD		DSA		OSHDP				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X		X	X		X						
Adopt Entire Chapter as amended (amended sections listed below)			X ¹					X	X	X	X		X
Adopt only those sections that are listed below												X	
Article/Section	Codes												
504.1	CA							X				X	
505.12	CA											X	
505.12.1	CA											X	
508.1.1	CA							X	X			X	
509.2.4	CA		X										
509.2.4.4	CA												X
510.7.1	UMC		†										
510.7.1.1	CA		X										
513.2.2	CA		X										
513.2.2.1	UMC												
513.10	CA		X										
513.10.1	CA		X										
513.10.2	CA		X										

1. This state agency adopts the entire chapter as amended except for those sections indicated by the following symbol: †

CHAPTER 6 – DUCT SYSTEMS

Adopting Agency		BSC	SFM	HCD		DSA		OSHDP				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X					X						
Adopt Entire Chapter as amended (amended sections listed below)			X	X	X			X	X	X	X		
Adopt only those sections that are listed below													
Article/Section	Codes												
601.2	CA			X	X								
602.1	CA		X										
602.1 Exc.	CA							X	X	X	X		
602.3.1	CA							X	X	X	X		
605.0	CA							X	X	X	X		
605.1	CA							X	X	X	X		
605.2	CA							X	X		X		
606.8	CA		X										
607.1.1	CA							X	X	X	X		
609.0	CA		X										

CHAPTER 7 – COMBUSTION AIR

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X	X	X	X		X	X	X	X	X		X
Adopt Entire Chapter as amended (amended sections listed below)													
Adopt only those sections that are listed below													
Article/Section	Codes												

CHAPTER 8 – CHIMNEYS AND VENTS

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X	X	X	X		X	X	X	X	X		
Adopt Entire Chapter as amended (amended sections listed below)													
Adopt only those sections that are listed below													
Article/Section	Codes												
Article/Section	Codes												

CHAPTER 9 – INSTALLATION OF SPECIFIC EQUIPMENT

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X					X			X			
Adopt Entire Chapter as amended (amended sections listed below)			X	X	X			X	X		X		
Adopt only those sections that are listed below													X
Article/Section	Codes												
902.0(D)	CA							X	X		X		
907.0	UMC												X
907.1	CA							X	X		X		
924.1	CA			X	X								
924.1.1	CA			X	X								
932.0	CA		X	X	X								
932.1	CA		X	X	X								
932.2	CA		X	X	X								
932.3	CA		X	X	X								
932.4	CA		X	X	X								
932.5	CA		X	X	X								

CHAPTER 10 – STEAM AND HOT WATER BOILERS

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X	X	X	X		X	X	X	X			X
Adopt Entire Chapter as amended (amended sections listed below)													
Adopt only those sections that are listed below													
Article/Section	Codes												

CHAPTER 11 – REFRIGERATION

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X	X	X	X		X						X
Adopt Entire Chapter as amended (amended sections listed below)							X	X	X	X			
Adopt only those sections that are listed below													
Article/Section	Codes												
1131.1	CA						X	X	X	X			
Table 11-1	CA						X	X	X	X			
Table 11-2	CA						X	X	X	X			

CHAPTER 12 – HYDRONICS

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X		X	X		X			X			
Adopt Entire Chapter as amended (amended sections listed below)							X	X			X		
Adopt only those sections that are listed below													
Article/Section	Codes												
1201.2.6	CA						X	X			X		

CHAPTER 13 – FUEL GAS PIPING

Adopting Agency		BSC	SFM	HCD		DSA		OSHPD				CA	DHS
				1	2	AC	SS	1	2	3	4		
Adopt Entire Chapter		X	X				X	X	X	X	X		
Adopt Entire Chapter as amended (amended sections listed below)													
Adopt only those sections that are listed below													
Article/Section	Codes												

“Enforcing Agency”. For the State of California, *“Building Official”* shall be the *“Enforcing Agency”* as specified in Section 111. [For OSHPD 1, 2, 3 & 4] *“Building Official”* shall be the *“Enforcing Agency”* as specified in California Chapter 1, Section 110.

205.0

–C–

CAS NUMBER – The Chemical Abstract System registry number.

CENTRAL HEATING PLANT or HEATING PLANT – Environmental heating equipment installed in a manner to supply heat by means of ducts or pipes to areas other than the room or space in which the equipment is located.

CERTIFIED – A formally stated recognition and approval of an acceptable level of competency, acceptable to the Authority Having Jurisdiction. [NFPA 96 3.3.9]

CHIMNEY – A vertical shaft enclosing one or more flues for conveying flue gases to the outside atmosphere.

Factory-Built Chimney – A listed chimney.

Masonry Chimney – A chimney of solid masonry units, bricks, stones, listed masonry units, or reinforced concrete, lined with suitable flue liners.

Metal Chimney – A chimney constructed of metal with a minimum thickness not less than 0.127 inch (3.23 mm) (No. 10 manufacturer’s standard gauge) steel sheet.

CHIMNEY CLASSIFICATIONS:

Chimney, Residential Appliance-Type – A factory-built or masonry chimney suitable for removing products of combustion from residential-type appliances producing combustion gases not in excess of 1,000°F (538°C), measured at the appliance flue outlet. Factory-built Type HT chimneys have high-temperature thermal shock resistance.

Chimney, Low-Heat Appliance-Type – A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning low-heat appliances producing combustion gases not in excess of 1,000°F (538°C) under normal operating conditions, but capable of producing combustion gases of 1,400°F (760°C) during intermittent forced firing for periods up to one hour. All temperatures are measured at the appliance flue outlet.

Chimney, Medium-Heat Appliance-Type – A factory-built, masonry, or metal chimney suitable for removing the products of combustion from

fuel-burning medium-heat appliances producing combustion gases not in excess of 2,000°F (1,093°C), measured at the appliance flue outlet.

Chimney, High-Heat Appliance-Type – A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning high-heat appliances producing combustion gases in excess of 2,000°F (1,093°C), measured at the appliance flue outlet.

CHIMNEY CONNECTOR – The pipe that connects a fuel-burning appliance to a chimney.

CLOSED COMBUSTION SOLID-FUEL-BURNING APPLIANCE – A heat-producing appliance that employs a combustion chamber that has no openings other than the flue collar, fuel-charging door, and adjustable openings provided to control the amount of combustion air that enters the combustion chamber.

CLOSET – See **Confined Space**.

CLOTHES DRYER – A appliance used to dry wet laundry by means of heat derived from the combustion of fuel gases.

CLOTHES DRYER, TYPE 1 – Primarily used in family living environment. May or may not be coin operated for public use. [NFPA 54: 3.3.18.1]

CLOTHES DRYER, TYPE 2 – Used in business with direct intercourse of the function with the public. May or may not be operated by public or hired attendant. May or may not be coin operated. [NFPA 54:3.3.18.2]

CODE – A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

COMBUSTION AIR – The total amount of air provided to the space that contains fuel-burning equipment. Includes air for fuel combustion, draft hood dilution, and ventilation of the equipment enclosure.

COMPRESSOR, POSITIVE DISPLACEMENT – A compressor in which increase in pressure is attained by changing the internal volume of the compression chamber.

COMPRESSOR, REFRIGERANT – A machine, with or without accessories, for compressing a refrigerant vapor.

CONDENSER – The part of the system designed to liquefy refrigerant vapor by removal of heat.

CONDENSING APPLIANCE – An appliance that condenses part of the water vapor generated by the burning of hydrogen in fuels.

CONDENSING UNIT – A mechanical refrigeration

system, consisting of one or more power-driven compressors, condensers, liquid receivers if provided, and the regularly furnished accessories that have been factory assembled and tested prior to its installation.

CONDITIONED SPACE – An area, room, or space normally occupied and being heated or cooled for human habitation by any equipment.

CONFINED SPACE – A room or space having a volume less than fifty (50) cubic feet (1.42 m³) per 1000 Btu/h (293 W) of the aggregate input rating of all fuel-burning appliances installed in that space.

COOLING – Air cooling to provide a room or space temperature of 68°F (20°C) or above.

COOLING SYSTEM – All of that equipment, including associated refrigeration, intended or installed for the purpose of cooling air by mechanical means and discharging such air into any room or space. This definition shall not include any evaporative cooler.

COOLING UNIT – A self-contained refrigeration system that has been factory assembled, tested, and installed with or without conditioned air and ducts, without connecting any refrigerant-containing parts. This definition shall not include a portable cooling unit or an absorption unit.

206.0 –D–

DAMPERS shall be defined as follows:

Fire Damper – An automatic-closing metal assembly of one or more louvers, blades, slats, or vanes complying with recognized standards.

Smoke Damper – A damper arranged to seal off airflow automatically through a part of an air duct system so as to restrict the passage of smoke.

Volume Damper – Any device that, when installed, will restrict, retard, or direct the flow of air in any duct, or the products of combustion in any heat-producing equipment, its vent connector, vent, or chimney.

DEPARTMENT – For applications listed in Section 108.2 regulated by the Department of Housing and Community Development, “Department” means the Department of Housing and Community Development.

DESIGN FLOOD ELEVATION – The elevation of the “design flood,” including wave height, relative to the datum specified on the community’s legally designated flood hazard map.

DIRECT GAS-FIRED MAKEUP AIR HEATER – A heater in which all the products of combustion generated by the gas-burning device are released into the outside airstream being heated.

DIRECT VENT APPLIANCE – An appliance that is constructed and installed so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

DISTRICT HEATING PLANT – A power boiler plant designed to distribute hot water or steam to users located off the premises.

DRAFT HOOD – A device built into an appliance or made a part of the vent connector from an appliance, that is designed to:

- (1) Assure the ready escape of the flue gases in the event of no draft, back draft, or stoppage beyond the draft hood.
- (2) Prevent a back draft from entering the appliance.
- (3) Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

DUCT – Any tube or conduit for transmission of air, fumes, vapors, or dusts. This definition shall not include:

- (1) A vent, vent connector, or chimney connector.
- (2) Any tube or conduit wherein the pressure of the air exceeds one (1) pound per square inch.
- (3) The air passages of listed self-contained systems.

DUCT FURNACE – A warm-air furnace normally installed in an air-distribution duct to supply warm air for heating. This definition shall apply only to a warm-air heating appliance that depends for air circulation on a blower not furnished as part of the furnace.

DUCT SYSTEM – Includes all ducts, duct fittings, plenums, and fans assembled to form a continuous passageway for the distribution of air.

DWELLING – A building or portion thereof that contains not more than two dwelling units.

DWELLING UNIT – A building or portion thereof that contains living facilities, including provisions for sleeping, eating, cooking, and sanitation, as required by this code, for not more than one family.

207.0 –E–

ELECTRIC HEATING APPLIANCE – A device that produces heat energy to create a warm environment by the application of electric power to resistance elements, refrigerant compressors, or dissimilar material junctions.

ELECTRICAL CODE – The National Electrical Code promulgated by the National Fire Protection Association, as adopted by this jurisdiction. [**HCD 1 and HCD 2**] Whenever the term “Electrical Code” is used

approved by the Department, that maintains a periodic inspection program of production of labeled products, installations, equipment, or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

LEL (Lower Explosive Limit). See LFL.

LFL (Lower Flammable Limit or Lower Limit of Flammability) – The minimum concentration of a combustible substance that is capable of propagating a flame through homogeneous mixture of the combustible and a gaseous oxidizer under the specified condition of test. The LFL is sometimes referred to as LEL (lower explosive limit). For the purposes of this definition, LFL and LEL are identical.

LINE CONTACT INSTALLATION – An installation in which a furnace is installed so that building joists, studs, or framing are contacted by the furnace jacket upon the lines formed by the intersection of the jacket sides with the top surface.

LIQUEFIED PETROLEUM GAS or LPG (LP Gas) – Means and includes a material composed predominantly of any of the following hydrocarbons or mixtures of them: propane, propylene, butanes (normal butane or isobutane), and butylenes. When reference is made to liquefied petroleum gas in this code, it shall refer to liquefied petroleum gases in either the liquid or gaseous state.

LISTED (THIRD PARTY CERTIFIED) – Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection on current production of listed equipment or materials and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner. [UPC:214.0] **[HCD 1 and HCD 2]** *“Listed” means all products that appear in a list published by an approved testing or listing agency. For additional information, see Health and Safety Code Section 17920(h).*

LISTED AND LISTING – [SFM] *“Listed” and “Listing” are terms referring to equipment or materials included in a list published by an approved testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of current productions of listed equipment or materials and which listing states that the material or equipment complies with approved nationally recognized codes, standards or tests and has been tested or evaluated and found suitable for use in a specific manner. These terms shall also mean equipment or materials accepted by the State Fire Marshal as conforming to the provisions of these regulations and which are included in a list published by the State Fire Marshal.*

LISTING AGENCY – An agency accredited by an independent and authoritative conformity assessment body to operate a material and product listing and labeling (certification) system and that is accepted by the Authority Having Jurisdiction, which is in the business of listing or labeling. The system includes initial and ongoing product testing, a periodic inspection on current production of listed (certified) products, and that makes available a published report of such listing in which specific information is included that the material or product conforms to applicable standards and found safe for use in a specific manner. [UPC:214.0] **[HCD 1 and HCD 2]** *“Listing Agency” means an agency approved by the Department that is in the business of listing and labeling products, materials, equipment, and installations tested by an approved testing agency, and that maintains a periodic inspection program on current production of listed products, equipment, and installations, and that, at least annually makes available a published report of these listings. For additional information, see Health and Safety Code Section 17920(i).*

LOW-PRESSURE HOT-WATER-HEATING BOILER – A boiler furnishing hot water at pressures not exceeding 160 pounds per square inch (1,102.4 kPa) and at temperatures not exceeding 250°F (121°C).

LOW-PRESSURE STEAM-HEATING BOILER – A boiler furnishing steam at pressures not exceeding fifteen (15) pounds per square inch (103.4 kPa).

LOW SIDE – Refers to the parts of a refrigeration system subjected to approximate evaporator pressure.

215.0

–M–

MACHINERY – The refrigeration equipment forming a part of the refrigeration system, including, but not limited to, the following: compressors, condensers, liquid receivers, evaporators, and connecting piping.

MACHINERY ROOM [SFM] – *Machinery Room is a room in which a refrigeration system is permanently installed and operated but not including evaporators located in a cold storage room, refrigerator box, air-cooled space or other enclosed space. Closets solely contained within, and opening only into, a room shall not be considered machinery rooms, but shall be considered a part of the machinery rooms in which they are contained or open into. It is not the intent of this definition to cause the space in which unit or self-contained systems of Group I refrigerants are located to be classified as machinery rooms.*

MANUFACTURER – The company or organization that evidences its responsibility by affixing its name, trademark, or trade name to equipment or devices.

MANUFACTURER’S INSTALLATION INSTRUCTIONS – Printed instructions included with equipment or devices for the purpose of providing information regarding safe and proper installation whether or not as part of the conditions of listing.

216.0 –N–

NONCOMBUSTIBLE – As applied to building construction material, means a material that in the form in which it is used is either one of the following:

- (1) Material of which no part will ignite and burn when subjected to fire.
- (2) Material having a structural base of noncombustible material as defined in 1 above, with a surfacing material not over 1/8 inch (3.2 mm) thick that has a flame-spread index not higher than fifty (50).

Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material conforming to 1 above. No material shall be classed as noncombustible that is subject to increase in combustibility or flame-spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

NUISANCE [HCD 1 and HCD 2] “Nuisance” shall mean any nuisance as defined in Health and Safety Code Section 17920(k).

Notes:

- (1) For applications subject to the Mobilehome Parks Act as referenced in Section 108.3.2.2 of this code, refer to California Code of Regulations, Title 25 Division 1, Chapter 2 of the definition of “Nuisance”.
- (2) For application subject to the Special Occupancy Parks Act as referenced in Section 108.3.2.3 of this code, refer to California Code of Regulations, Title 25, Division 1, Chapter 2.2 for the definition of “Nuisance”.

217.0 –O–

OCCUPANCY – The purpose for which a building or part thereof is used or intended to be used.

OCCUPANCY CLASSIFICATION – For the purpose of this code, certain occupancies are defined as follows: **[HCD 1, HCD 2 and SFM]** Refer to the California Building Code, Title 24, Part 2 for use and occupancy classification. **[OSHPD 1, 2, 3 & 4]**

Occupancy Classification shall be those as shown in the California Building Code. For the purpose of this code, certain occupancies are defined as follows:

Group A Occupancies

Group A Occupancies include the use of a building or structure, or a portion thereof, for the gathering together of fifty (50) or more persons for purposes such as civic, social, or religious functions, recreation, education or instruction, food or drink consumption, or awaiting transportation. A room or space used for assembly purposes by less than fifty (50) persons and accessory to another occupancy shall be included as a part of that major occupancy. Assembly occupancies shall include the following:

Division 1. A building or portion of a building having an assembly room with an occupant load of 1,000 or more and a legitimate stage.

Division 2. A building or portion of a building having an assembly room with an occupant load of less than 1,000 and a legitimate stage.

Division 2.1. A building or portion of a building having an assembly room with an occupant load of 300 or more without a legitimate stage, including such buildings used for educational purposes and not classed as a Group B or E Occupancy.

Division 3. A building or portion of a building having an assembly room with an occupant load of less than 300 without a legitimate stage, including such buildings used for educational purposes and not classed as a Group B or E Occupancy.

Division 4. Stadiums, reviewing stands, and amusement park structures not included within other Group A Occupancies. Specific and general requirements for grandstands, bleachers, and reviewing stands are in the Building Code.

Exception: Amusement buildings, or portions thereof, that are without walls or a roof and constructed to prevent the accumulation of smoke in assembly areas.

Group B Occupancies

Group B Occupancies shall include buildings, structures, or portions thereof for office, professional, or service-type transactions that are not classified as Group H Occupancies. Such occupancies include occupancies for the storage

of records and accounts and eating and drinking establishments with an occupant load of less than fifty (50).

Group E Occupancies

Division 1. Any building used for educational purposes through the 12th grade by fifty (50) or more persons for more than twelve (12) hours per week or four (4) hours in any one day.

Division 2. Any building used for educational purposes through the 12th grade by less than fifty (50) persons for more than twelve (12) hours per week or four (4) hours in any one day.

Division 3. Any building or portion thereof used for day-care purposes for more than six (6) persons.

Group F Occupancies

Group F Occupancies shall include the use of a building or structure, or a portion thereof, for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair, or processing operations that are not classified as Group H Occupancies.

Division 1. Moderate-hazard factory and industrial occupancies shall include factory and industrial uses that are not classified as Group F, Division 2 Occupancies.

Division 2. Low-hazard factory and industrial occupancies shall include facilities producing noncombustible or nonexplosive materials that, during finishing, packing, or processing, do not involve a significant fire hazard.

Group H Occupancies

Group H Occupancies shall include buildings or structures, or portions thereof, that involve the manufacturing, processing, generation, or storage of materials that constitute a high fire, explosion, or health hazard. For definitions, identification and control of hazardous materials and pesticides, and the display of nonflammable solid and nonflammable or noncombustible liquid hazardous materials in Group B, F, M, or S Occupancies, see the Fire Code.

Division 1. Occupancies with a quantity of material in the building in excess of those listed in the Building Code, that present a high explosion hazard.

Division 2. Occupancies where combustible dust is manufactured, used, or generated in such a manner that concentrations and

conditions create a fire or explosion potential.

Occupancies with a quantity of material in the building in excess of those listed in the Building Code that present a moderate explosion hazard or a hazard from accelerated burning.

Division 3. Occupancies where flammable solids, other than combustible dust, are manufactured, used, or generated.

Division 4. Repair garages not classified as Group S, Division 3 Occupancies.

Division 5. Aircraft repair hangars and heliports not classified as Group S, Division 5 Occupancies.

Division 6. Semiconductor fabrication facilities and comparable research and development areas in that hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in the Building Code.

Division 7. Occupancies having quantities of materials in excess of those listed in the Building Code that are health hazards.

Group I Occupancies

Division 1.1. Nurseries for the full-time care of children under the age of six (each accommodating more than five children).

Hospitals, sanitariums, nursing homes with nonambulatory patients, protective social-care facilities or homes with nonambulatory guests, and similar buildings (each accommodating more than five (5) patients).

Division 1.2. Health care centers for ambulatory patients receiving outpatient medical care that may render the patient incapable of unassisted self-preservation (each tenant space accommodating more than five (5) such patients).

Division 2. Nursing homes for ambulatory patients and homes for children six years of age or over (each accommodating more than five patients or children).

Division 3. Mental hospitals, mental sanitariums, jails, prisons, reformatories, and buildings where personal liberties of inmates are similarly restrained.

Group M Occupancies

Group M Occupancies shall include buildings, structures, or portions thereof, used for the

display and sale of merchandise, and involving stocks of goods, wares, or merchandise incidental to such purposes and accessible to the public.

Group R Occupancies

Division 1. Hotels and apartment houses. Congregate residences (each accommodating more than ten (10) persons).

Division 2. Not used.

Division 3. Dwellings and lodging houses. Congregate residences (each accommodating ten (10) persons or less).

Group S Occupancies

Group S Occupancies shall include the use of a building or structure, or a portion thereof, for storage not classified as a hazardous occupancy.

Division 1. Moderate-hazard storage occupancies shall include buildings or portions of buildings used for storage of combustible materials that are not classified as Group S, Division 2 or Group H Occupancies.

Division 2. Low-hazard storage occupancies shall include buildings or structures, or portions thereof, used for storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single-thickness divisions, or in paper wrappings, and shall include ice plants, power plants, and pumping plants.

Division 3. Division 3 Occupancies shall include repair garages where work is limited to exchange of parts and maintenance requiring no open flame or welding, motor vehicle fuel-dispensing stations, and parking garages not classed as Group S, Division 4 open parking garages or Group U private garages.

Division 4. Open parking garages.

Division 5. Aircraft hangars where work is limited to exchange of parts and maintenance requiring no open flame or welding, and helistops.

Group U Occupancies

Division 1. Private garages, carports, sheds, and agricultural buildings.

Division 2. Fences six (6) feet (1,829 mm) high, tanks, and towers.

OCCUPIED SPACE – An enclosed space intended for human activities excluding those spaces intended primarily for other purposes such as storage rooms and equipment rooms that are only occupied occasionally and for short periods of time.

218.0

–P–

PEL (Permissible Exposure Limit) – The maximum permitted eight-hour time-weighted average concentration of an airborne contaminant. The maximum permitted time-weighted average exposures to be utilized are those published in 29 CFR 1910.1000.

PEX – An acronym for cross-linked polyethylene.

PIPING – The pipe or tube mains for interconnecting the various parts of a system. Piping includes pipe, tube, flanges, bolting, gaskets, valves, fittings the pressure-containing parts of other components such as expansion joints, strainers, and devices that serve such purposes as mixing, separating, snubbing, distributing, metering, or controlling flow pipe-supporting fixtures and structural attachments.

PLENUM – An air compartment or chamber including uninhabited crawl spaces areas above a ceiling or below a floor, including air spaces below raised floors of computer/data processing centers or attic spaces, to that one or more ducts are connected and that forms part of either the supply-air, return-air or exhaust-air system, other than the occupied space being conditioned.

PLUMBING CODE – The Uniform Plumbing Code promulgated by the International Association of Plumbing and Mechanical Officials, as adopted by this jurisdiction. *[HCD 1 and HCD 2] Whenever the term “Plumbing Code” is used in this code, it shall mean the California Plumbing Code, Title 24, Part 5.*

PORTABLE COOLING UNIT – A self-contained refrigerating system, not over 3 horsepower rating, that has been factory assembled and tested, installed without supply-air ducts and without connecting any refrigerant-containing parts. This definition shall not include an absorption unit.

PORTABLE EVAPORATIVE COOLER – An evaporative cooler that discharges the conditioned air directly into the conditioned area without the use of ducts and can be readily transported from place to place without dismantling any portion thereof.

PORTABLE HEATING APPLIANCE – A heating appliance designed for environmental heating that may have a self-contained fuel supply and is not secured or attached to a building by any means other than by a factory-installed power supply cord.

PORTABLE VENTILATING EQUIPMENT – Ventilating equipment that can be readily transported from place to place without dismantling a portion thereof and that is not connected to a duct.

POSITIVE DISPLACEMENT COMPRESSOR – A compressor in which increase in pressure is attained

CHAPTER 3

GENERAL REQUIREMENTS

301.0 Scope.

This chapter covers general requirements for heating, ventilating, air-conditioning, refrigeration, miscellaneous heat-producing, and energy-utilizing equipment. Such equipment shall conform to the requirements of this code.

Equipment shall not be installed or altered in violation of this code, nor shall the fuel input rate to equipment be increased in excess of the approved Btu/h (kW) rating at the altitude where it is being used.

Defective material or parts shall be replaced in such a manner as not to invalidate any approval.

302.0 Approval.

302.1 How Obtained. Each appliance shall be approved by the Authority Having Jurisdiction for safe use or comply with applicable nationally recognized standards as evidenced by the listing and label of an approved agency. A list of accepted standards is included in Chapter 17.

302.2 Complying Design of Equipment. Installers shall furnish satisfactory evidence that the appliance is constructed in conformity with the requirements of this code. The permanently attached label of an approved agency may be accepted as such evidence.

302.3 Oil-Burning Appliances. The tank, piping, and valves for appliances burning oil shall be installed in accordance with the requirements of NFPA 31, Standard for the Installation of Oil-Burning Equipment.

303.0 Connecting Gas Equipment.

303.1 Gas utilization equipment shall be connected to the building piping in compliance with Section 1312.4 by one of the following:

- (1) Rigid metallic pipe and fittings.
- (2) Semi-rigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
- (3) Listed connectors used in accordance with the terms of their listing that are completely in the same room as the equipment.
- (4) Listed gas hose connectors in accordance with Section 303.2.
- (5) Gas-fired food service (commercial cooking) equipment listed for use with casters or otherwise subject to movement for cleaning,

and other large and heavy gas utilization equipment that can be moved, shall be connected in accordance with the connector manufacturer's installation instructions using a listed appliance connector complying with ANSI Z21.69, Standard for Connectors for Movable Gas Appliances.

- (6) In Sections 303.1(2), (3), and (5), the connector or tubing shall be installed so as 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 or are subject to repeated wettings by such liquids as water (except rainwater), detergents, or sewage.

303.2 Use of Gas Hose Connectors. Listed gas hose connectors shall be used in accordance with the terms of their listing and as follows:

- (A) **Indoor.** Indoor gas hose connectors shall be permitted to be used with laboratory, shop, or ironing equipment that requires mobility during operation. An equipment shutoff valve shall be installed where the connector is attached to the building piping. The connector shall be of minimum length and shall not exceed 6 feet. (1.8 m). The connector shall not be concealed and shall not extend from one room to another or pass through wall partitions, ceilings, or floors.
- (B) **Outdoor.** Outdoor gas hose connectors shall be permitted to be used to connect portable outdoor gas-fired equipment. An equipment shutoff valve, a listed quick-disconnect device, or a listed gas convenience outlet shall be installed where the connector is attached to the supply piping and in such a manner so as to prevent the accumulation of water or foreign matter. This connection shall only be made in the outdoor area where the equipment is to be used.

303.3 Connection of Portable and Mobile Industrial Gas Equipment.

- (A) Portable industrial gas utilization equipment or equipment requiring mobility or subject to vibration shall be permitted to be connected to the building gas piping system by the use of flexible hose suitable and safe for the conditions under which it can be used.

- (B) Industrial gas utilization equipment requiring mobility shall be permitted to be connected to the rigid piping by the use of swivel joints or couplings that are suitable for the service required. Where swivel joints or couplings are used, only the minimum number required shall be installed.
- (C) Industrial gas utilization equipment subject to vibration shall be permitted to be connected to the building piping system by the use of all metal flexible connectors suitable for the service required.
- (D) Where flexible connections are used, they shall be of the minimum practical length and shall not extend from one room to another or pass through any walls, partitions, ceilings, or floors. Flexible connections shall not be used in a concealed location. They shall be protected against physical or thermal damage and shall be provided with gas shutoff valves in readily accessible locations in rigid piping upstream from the flexible connections. [NFPA 54:8.5.1, 8.5.2, 8.5.3]

304.0 Installation.

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

304.2 Room Large in Comparison to Size of Equipment. Central-heating furnaces not listed for closet or alcove installation shall be installed in a room or space having a volume at least twelve (12) times the total volume of the furnace; central-heating boilers not listed for closet or alcove installation shall be installed in a room or space having a volume sixteen (16) times the volume of the boiler. **[For OSHPD 1, 2, 3 & 4]** *The total volume of the boilers shall be based on the total number of central-heating boilers that can operate at the same time.*

Exceptions:

- (1) The installation clearances for furnaces and boilers in rooms not large in comparison with the size of the equipment shall be as specified in the appliance listing regardless of whether the enclosure is of combustible or noncombustible materials and shall not be reduced by the protection methods described in Table 3-2 or any other method.
- (2) **[For OSHPD 1, 2, 3 & 4]** *A 25 percent reduction in the boiler room volume is allowed*

with forced-draft boilers and approved ventilation of the boiler room. In no case shall boiler room volume or clearances be reduced below those required by the conditions of the boiler listing. The boiler and the boiler room ventilation system, including fans, controls and damper motors shall be on emergency power when required by Section 316. The ventilation system shall either operate continuously, or, if interlocked with the boiler(s) it shall not interfere with the proper boiler operation.

If the ceiling height of the room or space is greater than eight (8) feet (2,438 mm), the volume shall be calculated on the basis of an eight (8) foot (2,438 mm) height.

304.3 Unlisted Appliances. Unlisted appliances shall be installed with the standard clearances from combustible construction specified in Table 3-1. Unlisted appliances may have the standard clearances of Table 3-1 reduced by employing the forms of protection specified in Table 3-2. Forms of protection specified in Table 3-2 may be utilized to reduce clearances to combustible construction for all applicable appliances.

304.4 Anchorage of Appliances. Appliances designed to be fixed in position shall be securely fastened in place. Supports for appliances shall be designed and constructed to sustain vertical and horizontal loads within the stress limitations specified in the Building Code.

304.5 Identification of Equipment. When more than one heating, cooling, ventilating, or refrigerating system is installed on the roof of a building or within a building, it shall be permanently identified as to the area or space served by the equipment.

304.6 Liquefied Petroleum Gas Facilities. Containers, container valves regulating equipment, and appurtenances for the storage and supply of liquefied petroleum gas shall be installed in accordance with the *California Fire Code*.

304.7 Liquefied Petroleum Gas Appliances.

[HCD 1 and HCD 2] *Liquefied petroleum gas-burning appliances shall not be installed in a pit, basement or similar location where heavier-than-air gas might collect. Appliances so fueled shall not be installed in an above-grade under-floor space or basement unless such location is provided with an approved means for removal of unburned gas.*

305.0 Access.

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

Unless otherwise specified, not less than thirty (30) inches (762 mm) in depth, width, and height of

Equipment Capacity in		Minimum Condensate Pipe Diameter	
Tons of Refrigeration	(kW)	Inches	(mm)
Up to 20	(Up to 70.34)	3/4	(20)
21–40	(73.85–140.67)	1	(25)
41–90	(144.19–316.6)	1-1/4	(32)
91–125	(320.03–439.6)	1-1/2	(40)
126–250	(443.12–879.2)	2	(50)

The size of condensate waste pipes may be for one unit or a combination of units, or as recommended by the manufacturer. The capacity of waste pipes assumes a 1/8 inch per foot (10.5 mm/m) or 1 percent slope, with the pipe running three-quarters full at the following conditions:

Outside Air – 20%		Room Air – 80%	
DB	WB	DB	WB
90°F	73°F	75°F	62.5°F
(32°C)	(23°C)	(24°C)	(17°C)

Condensate drain sizing for other slopes or other conditions shall be approved by the Authority Having Jurisdiction.

310.4 Fuel-Burning Appliance Condensate Drains. Condensate drain lines from individual fuel-burning condensing appliances shall be sized according to the manufacturer’s recommendations. Condensate drain lines serving more than one appliance shall be approved by the Authority Having Jurisdiction prior to installation.

310.5 Plastic Fittings. Female PVC screwed fittings shall be used with plastic male fittings and plastic male threads only.

311.0 Personnel Protection.

A suitable and substantial metal guard shall be provided around exposed flywheels, fans, pulleys, belts, and moving machinery that are portions of a heating, ventilating, or refrigerating system.

312.0 Air Filters.

312.1 Air filters shall be installed in a heating, cooling or makeup air system. Such filters shall comply with the standard, Air Filter Units, Test Performance of, that is referenced in Chapter 17, as Class I or II filters.

Exception: Systems serving single guest rooms or dwelling units shall not require a listed filter.

313.0 Scope

313.1 Applicability. This part is applicable to health facilities regulated by OSHPD. (See Adoption Tables for application for specific sections.)

Note: This section has no corresponding provisions in the UMC. For the scope and authority of each state agency, refer to Chapter 1.

313.2 Services/Systems and Utilities. Refer to Section 1224.4.1 California Building Code.

314.0 Steam and Hot-Water Systems

314.1 Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers. [For OSHPD 1 & 4]

314.1.1 Boilers shall have the capacity, based upon the rest ratings published by the Hydronics Institute or another acceptable national standard to supply the normal operating requirements of all connected systems and equipment.

314.1.2 A minimum of two boilers shall be provided. The arrangement of boilers shall be based on the capacity and capability of a boiler or boilers to operate all systems during-periods of breakdown or maintenance of any one boiler.

314.1.3 Boiler systems providing space heating shall be designed to maintain a minimum temperature of 60°F (15.6°C) in general patient areas and the temperatures specified in Table 315 for sensitive areas during periods of breakdown or maintenance of any one boiler. Winter design temperature shall be based on the Median of Extremes shown by the 1982 ASHRAE Climatic Data for Region X and ASHRAE 1994 Supplement to Climatic Data for Region X.

314.1.4 Boiler feed pumps, condensate return pumps, fuel oil pumps and heating circulating pumps shall be connected and installed to provide standby service in the event of pump failure. Installation of duplex pumps or provision of a spare pump will meet this requirement.

314.1.5 At least two sources of heat (e.g. two pieces of equipment) shall be provided for supplying essential services such as sterilizers, hot water for dishwashing, and domestic hot water for minimum patient service, such as handwashing and baths. Booster heaters for dishwashing providing 125°F to 180°F (52°C to 82°C) water may be counted as the second source of heat for that service.

314.2 Requirements for Skilled Nursing, Intermediate Care Facilities and Basic Services Provided in Correctional Treatment Centers. [For OSHPD 2 & 4]

314.2.1 Boilers, if provided, shall accommodate Section 314.1.

314.2.2 Two or more interconnected water heaters are an acceptable means to provide two sources of heat for hot water. See Section 314.1.5.

315.0 Air Conditioning and Heating Systems

315.1 Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers. [For OSHPD 1 & 4]

315.1.1 The systems shall be designed to provide the temperatures and humidity for sensitive areas or rooms shown in Table 315.

315.1.2 Individual temperature and humidity controls shall be provided for each designated sensitive area or room shown in Table 315.

Exceptions:

- (1) Dew-point control with individual overriding room humidistat will be acceptable as a substitute when justification is provided.
- (2) Rooms with similar exposure, function and humidity requirements may have humidity control with zone humidifier where designs are specifically approved by the enforcing agency.

315.1.3 For occupied areas not shown in Table 315, heating systems shall be designed to provide 70°F to 75°F (21.1°C to 23.9°C) based on the Median of Extremes shown by the 1982 ASHRAE Climatic Data for Region X and ASHRAE 1994 Supplement to Climatic Data for Region X. The systems shall be thermostatically controlled with appropriate zoning to achieve the above conditions.

315.1.4 For occupied areas not shown in Table 315, cooling systems shall be designed to provide 75°F (23.9°C) maximum based on the 0.5 percent summer design dry bulb temperatures shown by the 1982 ASHRAE Climatic Data for Region X and ASHRAE 1994 Supplement to Climatic Data for Region X. The systems shall be thermostatically controlled with appropriate zoning to achieve the above conditions.

315.2 Requirements for Skilled Nursing, Intermediate Care Facilities and Basic Services Provided in Correctional Treatment Centers. [For OSHPD 2 & 4]

315.2.1 Systems shall accommodate the provisions of Section 315.1.3 through 315.1.4.

315.2.2 Where air conditioning is provided, the system shall be thermostatically controlled in one or more zones.

315.3 Requirements for Outpatient Facilities and Licensed Clinics. [For OSHPD 3]

315.3.1 The system shall be designed to provide the temperature and humidities for sensitive areas for rooms shown in Table 315.

Table 315 – Heating, Cooling, and Relative Humidity Requirements for Sensitive Areas or Rooms

Area or Room Designation	Temperature Range ^{1,2}	Relative Humidity ^{1,3}
Operating room	68-73	30-60
Cystoscopy	68-73	30-60
Cardiac catheterization lab	70-75	30-60
Delivery room	68-73	30-60
Recovery room	70	30-60
Newborn nursery	75	30-60
Intensive-care newborn nursery	75-80	30-60
Intensive care	70-75	30-60

¹ Thermostats and humidistat shall be either locally resettable and of the non-locking type or remotely resettable and of the locking type.

² Where temperature ranges are indicated, the system shall be capable of maintaining the rooms at any point within the range. A single figure indicates a heating or cooling capacity of at least the indicated temperature. Temperatures different than those shown will be allowed when approved by the Authority Having Jurisdiction.

³ The ranges listed are the minimum and maximum limits where control is specifically needed.

316.0 Essential Mechanical Provisions [For OSHPD 1, 2, 3(Surgical Clinics only) & 4] During periods of power outages emergency electrical power shall be provided for the following equipment:

316.1 (Does not apply to OSHPD 3 surgical clinic.) All heating equipment necessary to maintain a minimum temperature of 60°F (15.6°) in patient areas which are not specified in Table 315.

316.2 All heating equipment necessary to maintain the minimum temperatures for sensitive areas as specified in Table 315.

316.3 Equipment necessary for humidification of the areas listed in Table 315.

316.4 All supply, return and exhaust fans required to maintain the positive and negative air balances as required in Table 4-A.

316.5 All control components and control systems necessary for the normal operation of equipment required to have emergency electrical power.

316.6 Alarms for airborne infection isolation rooms and protective environment rooms.

CHAPTER 4

VENTILATION AIR SUPPLY

401.0 General.

This chapter contains requirements for ventilation air supply and exhaust, evaporative cooling systems and makeup-air requirements for direct-gas-fired heaters, industrial air heaters, and miscellaneous heaters. **[OSHPD 1, 2, 3 & 4]** See Sections 404.0 through 418.0. **[SFM]** Air filters shall comply with all requirements of Part 12, Title 24, Chapter 12-71, SFM Standard 12-71-1.

402.0 Ventilation Air. [Not permitted for OSHPD 1, 2, 3 & 4]

402.1 General Requirements. [Not permitted for OSHPD 1, 2, 3 & 4] All rooms and occupied spaces listed in Table 4-1 shall be designed to have ventilation (outdoor) air for occupants in accordance with this chapter. *Ventilation air supply requirements for occupancies regulated by the California Energy Commission are found in the California Energy Code.*

402.1.1 Construction Documents. The outdoor air ventilation rate and air distribution assumptions made in the design of the ventilation system shall be clearly identified on the construction documents.

402.2 Natural Ventilation. Use of natural ventilation systems designed in accordance with this section shall be permitted in lieu of or in conjunction with mechanical ventilation systems. [ASHRAE 62.1:5.1]

Exception: An engineered natural ventilation system when approved by the Authority Having Jurisdiction need not meet the requirements of 402.2.1 and 402.2.2. [ASHRAE 62.1:5.1]

402.2.1 Location and Size of Openings. Naturally ventilated spaces shall be permanently open to and within twenty-five (25) feet (8 m) of operable wall or roof openings to the outdoors, the openable area of which is a minimum of 4 percent of the net occupiable floor area. Where the openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening. Where interior spaces without direct openings to the outdoors are ventilated through adjoining rooms, the opening between rooms shall be permanently unobstructed and have a free area of not less than 8 percent of the area of the interior room nor less than 25 ft² (2.3 m²). [ASHRAE 62.1:5.1.1]

402.2.2 Control and Accessibility. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied. [ASHRAE 62.1:5.1.2]

402.3 Mechanical Ventilation. Where natural ventilation is not permitted by this section or the Building Code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and exhaust air. The system shall operate so that all rooms and spaces are continuously provided with the required ventilation rate while occupied.

403.0 Ventilation Rates. [Not permitted for OSHPD 1, 2, 3 & 4] The design outdoor air intake flow rate for a ventilation system shall be determined in accordance with Sections 403.1 through 403.6.

403.1 Zone Calculations. Zone parameters shall be determined in accordance with Sections 403.1.1 through 403.1.3. [ASHRAE 62.1:6.2.2]

403.1.1 Breathing Zone Outdoor Airflow. The design outdoor airflow required in the breathing zone of the occupiable space or spaces in a zone, i.e., the *breathing zone outdoor airflow* (V_{bz}), shall be determined in accordance with Equation 4-1. [ASHRAE 62.1:6.2.2.1]

$$V_{bz} = R_p P_z + R_a A_z \quad (\text{Equation 4-1})$$

Where:

A_z = zone floor area: the net occupiable floor area of the zone ft.² (m²).

P_z = zone population: The largest number of people expected to occupy the zone during typical usage. If the number of people expected to occupy the zone fluctuates, P_z shall be permitted to be estimated based on averaging approaches described in Section 403.4. If P_z cannot be accurately predicted during design, it shall be estimated based on the zone floor area and the default occupant density listed in Table 4-1.

R_p = outdoor airflow rate required per person as determined from Table 4-1.

R_a = outdoor airflow rate required per unit area as determined from Table 4-1. [ASHRAE 62.1:6.2.2.1]

403.1.2 Zone Air Distribution Effectiveness. The *zone air distribution effectiveness* (E_z) shall be determined using Table 4-2. [ASHRAE 62.1:6.2.2.2]

403.1.3 Zone Outdoor Airflow. The design *zone outdoor airflow* (V_{oz}), i.e., the outdoor airflow that

must be provided to the zone by the supply air distribution system, shall be determined in accordance with Equation 4-2. [ASHRAE 62.1:6.2.2.3]

$$V_{oz} = V_{bz}/E_z \quad (\text{Equation 4-2})$$

403.2 Single-Zone Systems. When one air handler supplies a mixture of outdoor air and recirculated air to only one zone, the *outdoor air intake flow* (V_{ot}) shall be determined in accordance with Equation 4-3. [ASHRAE 62.1:6.3]

$$V_{ot} = V_{oz} \quad (\text{Equation 4-3})$$

403.3 100% Outdoor Air Systems. When one air handler supplies only outdoor air to one or more zones, the *outdoor air intake flow* (V_{ot}) shall be determined in accordance with Equation 4-4. [ASHRAE 62.1:6.2.4]

$$V_{ot} = \text{all zones } V_{oz} \quad (\text{Equation 4-4})$$

403.4 Multiple-Zone Recirculating Systems. When one air handler supplies a mixture of outdoor air and recirculated return air to more than one zone, the *outdoor air intake flow* (V_{ot}) shall be determined in accordance with Sections 403.4.1 through 403.4.4. [ASHRAE 62.1:6.2.5]

403.4.1 Primary Outdoor Air Fraction. When Table 4-3 is used to determine system ventilation efficiency, the *zone primary outdoor air fraction* (Z_p) shall be determined in accordance with Equation 4-5. [ASHRAE 62.1:6.2.5.1]

$$Z_p = V_{oz}/V_{pz} \quad (\text{Equation 4-5})$$

V_{pz} is the primary airflow to the zone from the air handler, including outdoor air and recirculated return air. [ASHRAE 62.1:6.2.5.1]

403.4.2 System Ventilation Efficiency. The *system ventilation efficiency* (E_v) shall be determined using Table 4-3 or Appendix A of ASHRAE 62.1. [ASHRAE 62.1:6.2.5.2]

403.4.3 Uncorrected Outdoor Air Intake. The design *uncorrected outdoor air intake* (V_{ou}) shall be determined in accordance with Equation 4-6. [ASHRAE 62.1:6.2.5.3]

$$V_{ou} = D \text{ all zones } R_p P_z + \text{all zones } R_a A_z \quad (\text{Equation 4-6})$$

The *occupant diversity*, D , shall be permitted to be used to account for variations in occupancy within the zones served by the system. [ASHRAE 62.1:6.2.5.3]

The *occupancy diversity* is defined as:

$$D = P_s / \text{all zones } P_z \quad (\text{Equation 4-7})$$

where the *system population* (P_s) is the total population in the area served by the system. Alternative methods shall be permitted to be used to account for population diversity when calculating V_{ou} , provided that the resulting value is no less than that determined by Equation 4-6. [ASHRAE 62.1:6.2.5.3]

403.4.4 Outdoor Air Intake. The design *outdoor air intake flow* (V_{ot}) shall be determined in accordance with Equation 4-8. [ASHRAE 62.1:6.2.5.4]

$$V_{ot} = V_{ou}/E_v \quad (\text{Equation 4-8})$$

403.5 Design for Varying Operating Conditions.

403.5.1 Variable Load Conditions. Ventilation systems shall be designed to be capable of providing the required ventilation rates in the breathing zone whenever the zones served by the system are occupied, including all full and part-load conditions. [ASHRAE 62.1:6.2.6.1]

403.5.2 Short-Term Conditions. If it is known that peak occupancy will be of short duration or the ventilation rate will be varied or interrupted for a short period of time, the design shall be permitted to be based on the average conditions over a time period T determined by Equation 4-9. [ASHRAE 62: Section 6.2.6.2]:

$$T = 3 v / V_{bz} \text{ (4-9) IP} \quad (\text{Equation 4-9})$$

where:

T = averaging time period, (min)

v = the volume of the zone for which averaging is being applied, ft^3 (m^3).

V_{bz} = the *breathing zone outdoor airflow* calculated using Equation 4-1 and the design value of the *zone population* P_z , cfm (L/s).

403.6 Dynamic Reset. The system shall be permitted to be designed to vary the design *outdoor air intake flow* (V_{ot}), or the space or zone airflow as operating conditions change.

403.7 Exhaust Ventilation. Exhaust airflow shall be provided in accordance with the requirements in Table 4-4. Exhaust makeup air shall be permitted to be any combination of outdoor air, recirculated air, and transfer air.

404.0 Makeup Air.

Makeup-air requirements for direct gas-fired heaters, industrial air heaters, and miscellaneous heaters are found in Chapters 5 and 9.

405.0 Evaporative Cooling Systems.

Evaporative cooling systems shall comply with this chapter.

Evaporative cooling systems shall be provided with outside air as specified for cooling systems in this code.

Air ducts and fire dampers that are a portion of an evaporative cooling system shall comply with this code.

405.1 Location.

Evaporative cooling systems shall be installed so as to minimize the probability of damage from an external source.

405.2 Access, Inspection, and Repair. Evaporative coolers shall be accessible for inspection, service, and replacement without removing permanent construction.

405.3 Installation.

An evaporative cooler supported by the building structure shall be installed on a substantial level base and shall be secured directly or indirectly to the building structure by suitable means to prevent displacement of the cooler.

Modifications made to the supporting framework of buildings as a result of the installation shall be in accordance with the requirements of the Building Code. Openings in exterior walls shall be flashed in an approved manner in accordance with the requirements of the Building Code.

An evaporative cooler supported directly by the ground shall be isolated from the ground by a level concrete slab extending not less than three (3) inches (76 mm) above the adjoining ground level.

An evaporative cooler supported on an aboveground platform shall be elevated at least six (6) inches (152 mm) above adjoining ground level.

Example: Determine the outdoor air rate required for a single zone AC unit serving an interior 2,000 ft.² meeting/conference room with a design occupancy of 100 people. The system supplies and returns air from the ceiling.

Per Table 4-2, the zone air distribution effectiveness is 1.0 since the system supplies cooling only from the ceiling. Using the rates from Table 4-1 for a meeting/conference room, the minimum system outdoor air rate is calculated to be:

$$\begin{aligned} \text{Vot} &= \frac{R_p P_z + R_a A_z}{E_z} \\ &= \frac{5 \times 100 + 0.06 \times 2,000}{1.0} \\ &= 620 \text{ cfm} \end{aligned}$$

405.4 Evaporative Cooling System for Health Care Facilities [For OSHPD 1, 2, 3 & 4] Direct evaporative cooling systems where the air directly contacts

the wetted surface or spray shall be limited in health facilities to nonpatient areas such as laundry rooms, food preparation areas and boiler or machinery rooms. Similar rooms with high heating-producing equipment will be considered when specifically approved by the enforcing agency. The evaporative pads, shall be a synthetic type. Filters shall be required in accordance with Tables 4-B and 4-C except utility rooms i.e.: boiler or machinery rooms.

406.0 Reserved.

407.0 Ventilation System Details [For OSHPD 1, 2, 3 & 4]

407.1 General.

407.1.1 All supply-air, return air, and exhaust-air systems shall be mechanically operated and such systems for areas listed in Table 4-A shall be operated continuously. Natural ventilation through windows or other openings such as louvers will be considered as supplemental to the required mechanical ventilation systems.

Exception 1. Natural ventilation shall not be used in airborne infection isolation rooms and protective environment rooms.

Exception 2. The number of air changes may be reduced to 25 percent of the indicated value in Table 4-A, when the room is unoccupied, if provisions are made to ensure the following: (1) the number of air changes per hour indicated is reestablished whenever the space is occupied and (2) the pressure relationship with the surrounding rooms is maintained when the air changes per hour are reduced. In areas requiring no continuous directional control as identified in accordance with Table 4-A, ventilation systems may be shut down when the space is unoccupied and ventilation is not otherwise required. Ventilation shall not be reduced in rooms specifically used for airborne infection control, such as waiting rooms, triage rooms, corridors, reception areas, areas adjacent to waiting areas, airborne infection isolation rooms, negative pressure exam room, negative pressure x-ray treatment rooms, and protective environment rooms. All operating and delivery rooms shall maintain a minimum of six air changes per hour of total air when not in use.

407.1.2 Fans serving exhaust systems shall be located at the discharge end of the system. The ventilation rates shown in Table 4-A shall be considered as minimum acceptable rates and shall not be construed as precluding the use of higher ventilation rates if they are required to meet design conditions.

407.1.3 Services/Systems and Utilities. See Section 313.2.

407.2 Outdoor Air Intakes and Exhaust Outlets.

407.2.1 Outdoor Air Intakes. Outdoor air intakes shall be located at least 25 feet (7.62 m) from exhaust outlets of ventilating systems, combustion equipment stacks, medical-surgical vacuum systems, cooling towers, plumbing vents, and areas that may collect vehicular exhaust or other noxious fumes. The bottom of outdoor air intakes shall be located as high as practicable, but not less than 10 feet (3048 mm) above ground level. If installed through the roof, they shall be located 18 inches (457 mm) above roof level or 3 feet (914 mm) above a flat roof where heavy snowfall is anticipated.

Exceptions:

1. These dimensions may be reduced if it is demonstrated by the submission of details and calculations that location of intakes with respect to exhausts and their orientation, or the use of special filters, provides equal performance.
2. The requirements regarding the bottom of outdoor air intakes and installation through the roof do not apply to skilled nursing facilities, intermediate-care facilities or nonsensitive areas in correctional treatment centers.

407.2.2 Exhaust Outlets. Exhaust outlets shall be located a minimum of 10 feet (3048 mm) above adjoining grade and 10 feet (3048 mm) from doors, occupied areas and operable windows.

Exception: Airborne infection isolation rooms shall comply with Section 414.1.

407.2.3 Relief Air Discharge. Building relief air discharge shall discharge at least 10 feet (3048 mm) from any outside air intake.

407.3 Air Balance.

407.3.1 The ventilation systems shall be designed and balanced to provide the general air balance relationship to adjacent areas, shown in Table 4-A. The ventilation systems shall be balanced in accordance with the latest edition of standards published by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB).

407.3.2 Where the variation in static pressure drop across filters is a significant portion of the total pressure drop, static pressure or pressure differential controls or constant volume devices may be required to ensure the maintenance of air balance relationships shown in Table 4-A regardless of filter loading.

Exception: This section does not pertain to skilled nursing facilities, intermediate-care facilities and nonsensitive areas in correctional treatment centers, except for airborne infection isolation rooms and protective environment rooms.

407.4 Air Circulation.

407.4.1 Air shall be introduced at the cleanest areas and removed at the dirtiest areas in order to reduce chances of airborne cross infection as follows:

407.4.1.1 Air supplied to operating rooms, cesarean operating rooms, cardiac catheterization labs, cystoscopy rooms, delivery rooms and nurseries, shall be delivered at or near the ceiling of the area served, and all air removed from the area shall be removed near floor level. Exhaust or recirculation inlets shall be located not less than 3 inches (76 mm) nor more than 8 inches (203 mm) above the finished floor. At least two exhaust or recirculation air inlets shall be used in all cardiac catheterization labs, cystoscopy rooms, operating rooms, and delivery rooms and shall be located not less than 3 inches (76 mm) nor more than 8 inches (203 mm) above the finished floor.

Exception: For airborne infection isolation rooms and protective environment rooms, see Section 414.0 and 415.0.

407.4.1.2 Room supply air outlets and room recirculation and exhaust air inlets installed in nonsensitive areas shall be located not less than 3 inches (76 mm) above the floor.

Exception: For airborne infection isolation rooms and protective environment rooms, see Section 414.0 and 415.0.

407.4.1.3 Corridors shall not be used to convey supply, return or exhaust air to or from any room if the corridor is required to be of fire resistive construction per the California Building Code.

Exception 1: Mechanically exhausted toilet rooms of 50 square feet (4.7 m²) or less and small rooms of 30 square feet (2.79 m²) or less such as janitor closets, housekeeping rooms, and electrical or telephone closets opening directly onto corridor.

Exception 2: Air transfer caused by pressure differentials in rooms required to have a positive or negative air balance by Table 4-A.

407.4.1.4 No space above a ceiling may be utilized as an outside-air, relief-air, supply-air, exhaust-air or return-air plenum.

Exception: Designs specifically approved by the enforcing agency.

407.4.1.5 Air from a patient room, exam room, treatment room shall not be transferred to another similar room without first having passed through air filters as required by Table 4-B or Table 4-C.

407.4.1.6 Supply outlets and return and exhaust air inlets shall be located to prevent short-circuiting.

407.5 Variable Air Volume.

407.5.1 Variable Air Volume Systems (VAV).

Variable air volume systems subjecting the patient to

a fluctuating air movement are not acceptable for airborne infection isolation rooms, protective environment rooms or those critically sensitive areas listed in Table 315. For nonsensitive areas, variable air volume systems meeting the following criteria can be considered:

407.5.1.1 The VAV system shall comply with code requirements for outside air, total air, and pressure relationship through the full range of operation from minimum to maximum.

407.5.1.2 The central return or exhaust fan shall be controlled to accomplish the variable air volume requirements of the individual rooms served by the fan as described in Section 407.5.1.3.

407.5.1.3 Variable air volume for return or exhaust air shall be accomplished by utilizing an automatic modulating damper in the return or exhaust air for each zone. The damper will modulate from full open to minimum position in conjunction with the supply air VAV terminal box.

408.0 Filters [For OSHPD 1, 2, 3 & 4]

408.1 General. Filter efficiencies shall be certified by the manufacturer and shall be based on ASHRAE Standard 52.1-1992, Gravimetric and Dust-spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter or ASHRAE Standard 52.2-1999, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size when specifically set forth in these standards.

408.1.1 A filter gauge shall be installed across each filter bank serving central air systems. The gauge shall be red lined or a filter alarm light installed to signal when the recommended maximum static pressure drop has been reached.

408.1.2 Central air-handling systems are defined as any unit requiring duct work on the supply or inlet side that serve more than one room.

408.1.3 Filter banks shall be visually inspected for torn media and bypass in filter frames by means of a flashlight or equivalent, both with fans in operation and stopped. Tears in media and bypass in filter frames shall be eliminated in accordance with the manufacturer's directions and the requirements of the enforcing agency prior to commencing operation of the system.

408.1.4 Central air-handling systems shall be maintained in a reasonably clean condition during construction and shall be cleaned as necessary prior to replacement of temporary filter used during construction to ensure that clean air will be delivered to the occupied spaces.

408.1.5 Filter bank No. 1 shall be located upstream of the air-conditioning equipment. Filter bank No. 2 and filter bank No. 3 shall be located downstream of the supply fan and all cooling and humidification

equipment with efficiencies as indicated in Table 4-B or Table 4-C.

Exception: Dry steam-type humidifiers for local room humidity control may be installed in the supply air duct downstream of the final filter bank where designs are specifically approved by the enforcing agency.

408.1.6 Filter bank No. 2 and filter bank No. 3 media shall be rigid or supported (noncollapsing type) and shall operate on the principles of impingement, straining and diffusion.

408.2 Filters for Hospitals.

408.2.1 All air-ventilation systems shall comply with code requirements of this section and shall have filter bank efficiencies as listed in Table 4-B.

408.2.2 Noncentral recirculating air systems providing cooling to high heat producing equipment located in nonsensitive areas shall have a filter with 30 percent average efficiency based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 8 based on ASHRAE Standard 52.2-1999.

408.2.3 Noncentral air systems serving any areas not listed in Table 4-B shall be provided with filter arrangement and efficiency specifically approved by the enforcing agency.

408.2.4 Noncentral recirculating air handling systems, for example, through-the-wall units, fan coil units, and heat pumps may be utilized for single patient rooms of one or more beds. Filtration for these units shall have a minimum weight arrestance value of 50 percent, based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 1, based on ASHRAE Standard 52.2-1999. The air ventilation system providing the minimum air changes of outdoor air shall comply with Table 4-B. These units may be used as recirculating units only. All outdoor air requirements shall be met by a separate central air handling systems.

408.3 Filters for Skilled Nursing Facilities, Intermediate Care Facilities and Correctional Treatment Centers.

408.3.1 The air ventilation systems shall comply with code requirements of this section for skilled nursing facilities, intermediate care facilities and correctional treatment centers and shall have filter bank efficiencies as listed in Table 4-C.

408.3.2 Noncentral air systems serving single patient rooms of one or more beds shall comply with Table 4-C.

408.3.3 Noncentral recirculating air-handling systems, i.e. through the wall units, may be utilized for each patient room with one or more beds. Filtration for these units shall have a minimum weight arrestance value of 50 percent, based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 1, based on

ASHRAE Standard 52.2-1999. The air ventilation system providing the minimum air changes of outdoor air shall comply with Table 4-C. These units may be used as recirculating units only. All outdoor air requirements shall be met by a separate central air handling system.

408.3.4 Airborne infection isolation rooms, protective environment rooms and sensitive areas in correctional treatment centers shall comply with Section 408.2.

408.4 Filters for Outpatient Facilities.

408.4.1 The air ventilation systems shall comply with code requirements of this section for outpatient facilities and shall have filter bank efficiencies as listed in Table 4-B.

408.4.2 Noncentral air systems serving individual rooms shall comply with Table 4-B.

409.0 Ducts [FOR OSHPD 1, 2, 3 & 4]

409.1 Ducts which penetrate construction, intended for X-ray or other radiation protection, shall not impair the effectiveness of the protection.

409.2 Duct linings and their use shall meet the requirements of Chapter 6, California Mechanical Code.

409.3 Cold-air ducts shall be insulated wherever necessary or to prevent condensation problems.

409.4 The anchorage and supporting structural elements for airducts shall be designed to withstand the lateral forces as required by the California Building Code, Title 24, Part 2.

410.0 Laboratories [For OSHPD 1, 2, 3 & 4]

410.1 The minimum amount of outdoor air in laboratories shall be provided in accordance with Table 4-A. A filter with 90 percent average efficiency based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 14, based on ASHRAE Standard 52.2-1999 shall be installed in the air-supply system at its entrance to the media transfer room.

410.2 Laboratory hoods for general use shall have a minimum average face velocity of 75 feet per minute (380 m/s). Hoods in which infectious or highly radioactive materials are processed shall have a face velocity of 100 feet per minute (510 m/s). Bacteriological safety cabinets used for processing infectious materials shall have an average face velocity of 50 to 70 feet per minute (255 m/s to 355 m/s) and shall be equipped with a means for disinfection.

410.3 Laboratory hoods shall not be connected to the general building exhaust system. Hoods in which infectious, incompatible or highly radioactive materials are processed each shall have an independent exhaust system with the fan installed at the discharge point of the system. Duct systems serving laboratory hoods shall be constructed of stainless steel of a type which will resist corrosion by materials normally handled. Duct systems serving laboratory hoods used for purposes other than

those needed for routine diagnostic laboratory procedures and in which highly radioactive materials or a significant volume of highly oxidizing agents are used shall be constructed of USS 18-8 stainless steel or the equivalent for a minimum distance of 10 feet (3048 mm) from the hood. Such ducts shall be equipped with wash down facilities and shall be consistent with fire safety requirements. Fire dampers and smoke dampers shall not be installed in laboratory hood exhaust systems.

410.4 The exhaust from all laboratory hoods in which infectious or radioactive materials are processed shall be equipped with filters having a 99 percent efficiency based on the DOP (dioctylphthalate) test method or a minimum efficiency reporting value (MERV) of 15, based on ASHRAE Standard 52.2-1999. Filter frames shall be durable and carefully dimensioned, and shall provide an airtight fit with the enclosing duct work. All joints between filter segments and the enclosing duct work shall be gasketed or sealed to provide a positive seal against air leakage.

411.0 Kitchen and Dining Areas [For OSHPD 1, 2, 3 & 4]

411.1 The air from dining areas may be used to ventilate the food preparation areas only after it has passed through a filter with at least an 80 percent average efficiency based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 13, based on ASHRAE Standard 52.2-1999.

Exception: For skilled nursing facilities, intermediate care facilities and correctional treatment centers, the air from dining area may be used to ventilate food preparation areas only after it has passed through a filter with a 50 percent average efficiency based on ASHRAE Standard 52.1-1992 or a minimum efficiency reporting value (MERV) of 10, based on ASHRAE Standard 52.2-1999.

412.0 Boiler, Mechanical and Electrical Rooms [For OSHPD 1, 2, 3 & 4]

412.1 Boiler, heater and electrical equipment rooms shall be provided with outdoor air so as to maintain combustion rates of equipment and temperatures in the rooms and in adjoining areas as rated in this chapter.

412.2 Floor surfaces in occupied spaces above such rooms should not exceed a temperature of 85°F (29.4°C), and suitable insulation may be required.

413.0 Odorous Rooms [For OSHPD 1, 2, 3 & 4]

413.1 Rooms in areas where excessive heat or moisture is generated, where objectional odors or dust are present, or where flammable or toxic gases may accumulate, which are used by health facility personnel or patients, shall be provided with exhaust ventilation to change the air a minimum of ten times per hour.

413.2 Kitchen, morgues and laundries located inside a hospital building or skilled nursing facility in which patients are accommodated, or treated, shall be ventilated

with exhaust systems which will provide a minimum of ten air changes per hour and prevent odors from entering patient areas.

414.0 Airborne Infection Isolations Rooms [For OSHPD 1, 2, 3 & 4]

414.1 Exhaust Systems. A separate, dedicated exhaust system shall be provided for airborne infection isolation rooms. The dedicated system may serve more than one airborne infection isolation room, adjoining toilet room and anteroom. The exhaust ducts shall be identified by appropriate labeling with the words "Caution Airborne Infection Isolation Rooms Exhaust" or similar terminology. Such labeling shall be in a manner which is not readily removable and shall appear on the exhaust duct at intervals of not more than 20 feet (6096 mm) and at least once near each room and each story traversed by the exhaust system. Exhaust fans shall comply with Section 407.1.2. The discharge from exhaust fans shall be located above the roof and shall be located a minimum of 25 feet (7620 mm) from areas that may be occupied, doors, operable windows, outdoor air intakes, or other openings into the building. The exhaust fan discharge shall be labeled in a manner which readily identifies the precautions which should be observed. To ensure that the airborne contaminants do not reenter the building, one of the following shall be provided:

414.1.1 Exhaust discharge from fan shall extend at least 7 feet (2134 mm) above the roof and discharge vertically upward. Self-draining stacks or equivalent shall be used for rain protection. Rain caps which divert the exhaust toward the roof shall be prohibited; or

414.1.2 Exhaust shall discharge above roof level and through an accessible HEPA filter. The HEPA filter shall be located upstream of the exhaust fan and have a minimum efficiency of 99.97 percent based on the DOP method in accordance with Mil-Std. 282 or a minimum efficiency reporting value (MERV) of 17, based on ASHRAE Standard 52.2 1999. Filter gage shall be installed across the filter. For maintenance of air balance relationship, see Section 407.3.2. The 25-foot (7620 mm) dimension required by Section 414.1 may be reduced when a 99.97 percent HEPA filter or a minimum efficiency reporting value (MERV) of 17, based on ASHRAE Standard 52.2 1999 is used and the reduced dimension is specifically approved by the enforcing agency.

414.2 Air Distribution. The supply outlets and exhaust inlets shall be located to provide airflow patterns that prevent stagnation of the air and eliminate short circuiting of the supply to the exhaust, and minimize exposure of health care workers to airborne infectious particles. Supply-air outlets shall be located at or near the ceiling and at the end of the airborne infection isolation room which is opposite the head of the bed. Exhaust

registers shall be located on the wall behind the patient's head, or as close to that wall as practical and shall be located not less than 3 inches (76 mm) nor more than 24 inches (610 mm) above the finished floor.

Exception: For correctional treatment centers, the location and design of the supply outlets and exhaust or return inlets shall not compromise the safety, security and protection of staff, inmates and property.

415.0 Protective Environment Rooms [For OSHPD 1, 2, 3 & 4]

415.1 Air Distribution. The supply outlets and exhaust and return inlets shall be located to provide airflow patterns that prevent stagnation of the air and eliminate short circuiting of the supply to the exhaust or return. Supply air shall be delivered at or near the ceiling and near the patient's bed. All exhaust or return registers shall be located near the entrance to the protective environment room and not less than 3 inches (76 mm) nor more than 8 inches (203 mm) above the finished floor.

Exception: For correctional treatment centers, the location and design of the supply outlets and exhaust or return inlets shall not compromise the safety, security and protection of staff, inmates and property.

416.0 Alarms – Airborne Infection Isolation Rooms and Protective Environment Rooms [OSHPD 1, 2, 3 & 4]

416.1 An alarm system which is based on static pressure control, volumetric control, or directional flow measurement shall be provided for each isolation room. The alarm system shall consist of a display monitor located on the corridor wall near the door to the room and a visual and audible alarm which annunciates at the room and at a nurses' station or other suitable location that will provide responsible surveillance. A time delay shall be provided to allow for routine openings of doors. The alarm shall annunciate when the supply, return, or exhaust fans are interrupted and when one of the following conditions is not being met during closed door conditions:

1. When the minimum air quantity difference of 75 cfm (35.4 L/s) required by Table 4-A is not being maintained; or
2. When a minimum pressure differential of 0.001 inch (0.003 kPa) of water and a minimum inward (outward for protective environment rooms) air velocity of 100 feet per minute (0.508 m/s) is not being maintained at the air transfer opening required by Table 4-A.

416.2 Other acceptable alarm systems will be allowed when designs are specifically approved by the enforcing agency.

416.3 [For OSHPD 4] For correctional treatment centers, the alarm system shall not create false alarms or security hazards.

416.4 Prior to acceptance of the rooms, the alarm system shall be tested and operated to demonstrate to the owner or designated representative that the installation and performance of the system conforms to design intent.

417.0 Testing Airborne Infection Isolation Rooms and Protective Environment Room [For OSHPD 1, 2, 3 & 4] Prior to acceptance of the rooms, all mechanical systems shall be tested, balanced and operated to demonstrate to the owner or designated representative that the installation and performance of the systems conform to design intent. All testing and balancing shall be performed by a qualified independent agency certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). Test results shall be documented for maintenance files.

418.0 Design Requirements for Ethylene Oxide (ETO) Sterilization Areas [For OSHPD 1, 2, 3 & 4]

418.1 Air Changes. The ETO sterilization equipment room shall be provided with minimum air changes per hour per Table 4-A and be maintained at a negative air balance.

418.2 Exhaust Requirements.

418.2.1 All air from the ETO sterilizer equipment room shall be exhausted to the outside by a dedicated system or other approved method.

418.2.2 The exhaust fan for the dedicated system shall be located at the discharge point of the system and identified as ETO Equipment Room Exhaust.

418.2.3 Discharge Point. The discharge point shall be a minimum of 25 feet (7620 mm) away from any outside intake, operable window or personnel passage.

418.3 Ventilation Requirements.

418.3.1 Aeration units. The aeration units shall be ventilated through a nonrecirculating dedicated ventilation exhaust system.

418.3.2 Capture box. When the drain is not located in the ETO sterilizer equipment room, ventilation is required by a capture box.

418.3.3 Cylinder change. When not located in the ETO sterilizer equipment room, exhaust during cylinder change is required by installing a hood that is part of a dedicated ventilation exhaust system, positioned no more than 1 foot (305 mm) above or behind the point where the change of cylinders takes place.

418.3.4 Sterilizer relief valve. The ventilation of sterilizer relief valve is required through a pipe connected to the outlet of the relief valve exhausted directly to the outdoors at a point high enough to be away from passers-by, and not near any windows that open, nor near any air-conditioning or ventilation air intakes.

418.3.5 Ventilation of sterilizer door area. The system shall be designed to capture the ETO when the door is opened following the completion of the sterilization process. A hood or canopy closed on each end should be installed over the sterilization door. A

hood or canopy shall be connected to a dedicated exhaust ventilation system.

418.4 Gas Valves. Installation of gas line hand valves at the connection to the supply cylinders are required to minimize leakage during cylinder change.

418.5 Alarm Systems. An Audible and visual alarm system shall be installed to alert sterilizer operating personnel if the air flow falls below design cubic feet per minute(L/S).

TABLE 4-A – PRESSURE RELATIONSHIP AND VENTILATION REQUIREMENTS FOR GENERAL ACUTE CARE HOSPITALS, SKILLED NURSING FACILITIES, INTERMEDIATE CARE FACILITIES, CORRECTIONAL TREATMENT CENTERS, OUTPATIENT FACILITIES AND LICENSED CLINICS

A Area Designation	B AIRBALANCE RELATIONSHIP TO ADJACENT AREAS⁸	C MINIMUM AIR CHANGES IF 100% O.S.A.	D CONDITIONED AIR NOT 100% O.S.A		F ALL AIR EXHAUSTED DIRECTLY TO OUTDOORS
			Minimum Air Changes of Outdoor Air per hour	Minimum Total Air Changes per hour	
Operating room, cardiac catheterization lab and cystoscopy	P ⁷	12	5	20	
Patient holding preparation ¹	NR	6	2	6	
Delivery room, cesarean operating room	P	12	5	20	
Newborn/well baby nursery	P	6	2	6	
Post anesthesia care unit	NR	6	2	6	Yes
intensive care service spaces, acute respiratory - care service spaces, burn service spaces, coronary - care service spaces, pediatric intensive - care service spaces ⁹	P	6	2	6	
Newborn intensive care	P	6	2	6	
Emergency department: ¹					
Waiting area	N	12	2	12	Yes ²
Operating room	P	12	5	20	
Treatment room	NR	6	2	6	
Trauma room ³	P	12	5	20	
Triage	N	12	2	12	
Patient room	NR	2	2	6	
IV Prep. room	P	6	2	6	
Blood draw/phlebotomy	NR	6	2	6	
Infusion room	P	6	2	6	
Blood bank/tissue storage	NR	6	2	6	
Administrative	NR	4	2	4	
Patient area corridor	NR	2	2	4	
Labor/delivery/recovery room, Labor/delivery/recovery/postpartum room	NR	2	2	6	
Airborne infection isolation room	N ⁴	12	2	12	Yes
Airborne infection isolation anteroom	P ⁴	10	2	10	Yes
Protective environment room	P ⁵	15	2	15	
Protective environment anteroom	N ⁶	15	2	15	
Treatment and examination rooms, Bloodborne infection isolation room	NR	6	2	6	
Bronchoscopy and endoscopy	N	12	2	12	Yes
Special purpose room (SNF & ICF only)	NR	6	2	6	Yes
Radiological/Imaging: Angiography room	P	12	5	15	

A Area Designation	B AIRBALANCE RELATIONSHIP TO ADJACENT AREAS⁶	C MINIMUM AIR CHANGES IF 100% O.S.A.	E CONDITIONED AIR NOT 100% O.S.A.		F ALL AIR EXHAUSTED DIRECTLY TO OUTDOORS
			D Minimum Air Changes of Outdoor Air per hour	Minimum Total Air Changes per hour	
			<i>X-ray (diagnostic and treatment)</i>	NR	
<i>CT Scan</i>	NR	6	2	6	
<i>MRI room</i>	NR	6	2	6	
<i>Fluoroscopy room</i>	N	6	2	6	Yes
<i>Dark room</i>	N	12	2	12	Yes
<i>Negative-pressure x-ray room</i>	N	12	2	12	Yes
<i>Ultra sound room</i>	NR	6	2	6	
<i>Gamma camera</i>	NR	6	2	6	
<i>Waiting area</i>	N	12	2	12	Yes
<i>Nuclear Medicine</i>	N	6	2	6	Yes
<i>Bedpan room</i>	N			10	Yes
<i>Bathroom</i>	N			10	Yes
<i>Janitors' closet, housekeeping room</i>	N			10	Yes
<i>Sterilizer equipment room</i>	N			10	Yes
<i>Sub sterile room</i>	NR	10	2	10	Yes
<i>Linen and trash chute rooms</i>	N			10	Yes
<i>Food preparation centers</i>	NR	10	2	10	Yes
<i>Dining room</i>	NR	10	2	10	
<i>Dishwashing room</i>	N			10	Yes
<i>Dietary day storage</i>	NR			2	
<i>Laundry, general (clean and dirty)</i>	NR	10	2	10	Yes
<i>Soiled linen sorting and storage</i>	N			10	Yes
<i>Clean linen storage</i>	P	2	2	2	
<i>Anesthesia storage</i>	NR	8		8	Yes
<i>Central medical and surgical supply:</i>					
<i>Soiled or decontamination room</i>	N	4	2	4	Yes
<i>Clean workroom</i>	P	4	2	4	
<i>Unsterile supply</i>	NR	2	2	2	
<i>Pharmacy/medicine room</i>	P	2	2	4	
<i>Laboratory</i>					
<i>General</i>	N	6	2	6	
<i>Biochemistry</i>	P	6	2	6	
<i>Cytology</i>	N	6	2	6	Yes
<i>Glass washing</i>	N	10	2	10	Yes
<i>Histology</i>	N	6	2	6	Yes
<i>Microbiology</i>	N	6	2	6	Yes
<i>Pathology</i>	N	6	2	6	Yes
<i>Serology</i>	P	6	2	6	
<i>Sterilizing</i>	N	10	2	10	Yes
<i>Media transfer</i>	P	4	2	4	
<i>Infectious disease and virus</i>	N	6	2	6	Yes
<i>Bacteriology</i>	N	6	2	6	Yes
<i>Negative-pressure treatment/exam room</i>	N	12	2	12	Yes
<i>Physical therapy and hydrotherapy</i>	N	6	2	6	

A	B	C	E		F
			D	E	
Area Designation	AIRBALANCE RELATIONSHIP TO ADJACENT AREAS ⁶	MINIMUM AIR CHANGES IF 100% O.S.A.	CONDITIONED AIR NOT 100% O.S.A		ALL AIR EXHAUSTED DIRECTLY TO OUTDOORS
			Minimum Air Changes of Outdoor Air per hour	Minimum Total Air Changes per hour	
Soiled workroom (utility room)	N	4	2	10	Yes
Clean workroom	P	4	2	6	
Autopsy	N	12	2	12	Yes
Toilet room	N			10	Yes
Shower room	N			10	Yes
Waiting area primary care clinic	N	10	2	10	Yes ²

P = Positive NR = No requirement for continuous directional control N = Negative

¹ The pressure relationship of the entire emergency department shall be negative to other adjacent areas.

² Air may be recirculated if a high-efficiency particulate air (HEPA) filter with a minimum efficiency of 99.97 percent or a minimum efficiency reporting value (MERV) of 17 is installed in the return air duct which serves the waiting area.

³ The term "trauma room" as used here is the operating room space in the emergency department or other trauma reception area that is used for emergency surgery. The first aid room and/pr "emergency room" used for initial treatment of accident victims may be ventilated as noted for the "treatment rooms."

⁴ The anteroom shall have positive air pressure in relation to the airborne infection isolation room. A door louver, transfer grille, or other acceptable means shall be provided to allow for airflow from the anteroom to the airborne infection isolation room. The airborne infection isolation room shall have negative pressure in relation to the anteroom, and the adjoining toilet room shall have negative pressure in relation to the airborne infection isolation room. Negative pressure shall be achieved by balancing the exhaust cfm to no less than 75 cfm (35.4 L/s) greater than the supply cfm for each airborne infection isolation room the anteroom serves. The overall area consisting of the anteroom, airborne infection isolation room, and adjoining toilet room shall have an equal air balance in relation to the corridor.

Exception: For correctional treatment centers, the location and design of the air transfer device shall not compromise the safety, security and protection of staff, inmates, and property.

⁵ Positive-pressure shall be achieved by balancing the supply cfm to not less than 75 cfm (35.4 L/s) greater than the exhaust and return cfm for each protective environment room the anteroom serves.

⁶ The anteroom shall have negative air pressure in relation to the protective environment room. A door louver, transfer grille, or other acceptable means shall be provided to allow for airflow from the protective environment room to the anteroom. The protective environment room shall have positive-pressure in relation to the anteroom and adjoining toilet room. Positive pressure shall be achieved by balancing the supply cfm to not less than 75 cfm (35.4 L/s) greater than the exhaust and return cfm. The overall area consisting of the anteroom, protective environment room, and adjoining toilet room shall have an equal air balance in relation to the corridor.

Exception: For correctional treatment centers, the location and design of the air transfer device shall not compromise the safety, security, and protection of staff, inmates, and property.

⁷ Cystoscopy may have no requirement for continuous directional control when approved by Authority Having Jurisdiction.

⁸ For operating rooms, cardiac catheterization labs, angiography rooms, cystoscopy rooms, delivery rooms, cesarean operating rooms, newborn intensive care, intensive care units, and nurseries provide approximately 15% excess supply air to the room or a sufficient quantity of excess supply air to maintain an appropriate positive air balance based on the room tightness and number of doors. For all rooms not listed in this footnote or not listed in Table 315 requiring either a positive or negative air balance, provide approximately 10% differential cfm between supply and return/exhaust airflow but not less than 25 cfm differential shall be provided regardless of room size. Room function, size, and tightness may be considered when determining the differential airflow required. Where continuous directional control is not required, variations between supply cfm and return or exhaust cfm shall be minimized.

⁹ Intensive care patient rooms that contain a modular toilet/ sink combination unit within the room shall be provided with a minimum of 75 cfm of exhaust directly over the modular toilet/sink combination unit.

TABLE 4-B – Filter Efficiencies for Central Ventilation and Air-Conditioning Systems in General Acute Care Hospitals, Acute Psychiatric Hospitals, Outpatient Facilities and Licensed Clinics.¹

Area Designation	Minimum Number of Filter Banks	Filter Efficiency % Filter Bank (Minimum efficiency reporting value MERV) ⁵		
		No. 1 ¹	No. 2 ¹	No. 3 ¹
Orthopedic operating room, bone marrow transplant operating room, organ transplant operating room	3	30%	90%	99.97% ³
		(8)	(14)	(17)
Protective environment rooms	3	30%	90%	99.97% ⁴
		(8)	(14)	(17)
II Angiography; cardiac catheterization labs; operating rooms; delivery rooms nurseries; patient care, treatment, cystoscopy, cesarean operating room, diagnostic and related areas; airborne infection isolation rooms; areas providing direct patient service or clean supplies such as sterile and clean processes	2	30%	90%	
		(8)	(14)	
Laboratories	2	30%	80%	
		(8)	(13)	
II Administrative, med staff support areas, bulk storage, soiled holding areas, food preparation areas, public cafeterias and laundries	1	30%		
		(8)		

¹ Based on ASHRAE Standard 52.1-1992 or ASHRAE Standard 52.2-1999.

² Based on DOP test in accordance with MIL-STD-282 or based on ASHRAE Standard 52.2-1999.

³ HEPA filters at air outlet or other locations when approved by the Authority Having Jurisdiction.

⁴ HEPA filter located in the supply duct which serves the positive-pressure isolation room or rooms may serve more than one supply outlet and more than one positive-pressure isolation room. HEPA filter or a filter with minimum efficiency reporting value (MERV) of 17 installation shall be designed and equipped to permit safe removal, disposal and replacement of filters.

⁵ The numbers in parentheses represent MERV rating based on ASHRAE Standard 52.2-1999.

TABLE 4-C – Filter Efficiencies for Central Ventilation and Air-Conditioning Systems in Skilled Nursing Facilities and Intermediate Care Facilities and Correctional Treatment Centers.¹

Area Designation	Minimum Number of Filter Banks	Filter Efficiency % Filter Bank (Minimum efficiency reporting value MERV) ³	
		No. 1 ¹	No. 2 ¹
All areas for inpatient care, treatment and/or diagnosis, and those areas providing direct service or cleaning supplies	2	30%	80%
		(8)	(13)
Administrative, bulk storage, soiled holding, laundries and food prep areas	1	30% ² (8)	

¹ Based on ASHRAE Standard 52.1-1992 or ASHRAE Standard 52.2-1999.

² Filters are not required for evaporative coolers serving laundries and food preparation areas.

³ The numbers in parentheses represent MERV rating based on ASHRAE 52.2-1999.

TABLE 4-2
Zone Air Distribution Effectiveness
 [ASHRAE 62.1:Table 6-2]

Air Distribution Configuration	<i>E_z</i>
Ceiling supply of cool air	1.0
Ceiling supply of warm air and floor return	1.0
Ceiling supply of warm air at least 15°F (8°C) above space temperature	0.8
and ceiling return.	
Ceiling supply of warm air less than 15°F (8°C) above space	1.0
temperature and ceiling return provided that the 150 fpm (0.8 m/s)	
supply air jet reaches to within 4.5 ft. (1.4 m) of floor level.	
Floor supply of cool air and ceiling return provided that the 150 fpm	1.0
(0.8 m/s) supply jet reaches at least 4.5 ft. (1.4 m) above the floor.	
Floor supply of cool air and ceiling return, provided low velocity	1.2
displacement ventilation achieves unidirectional flow and thermal	
stratification.	
Floor supply of warm air and floor return	1.0
Floor supply of warm air and ceiling return	0.7
Makeup supply drawn in on the opposite side of the room from the	0.8
exhaust or return.	
Makeup supply drawn in near to the exhaust or return location	0.5

Notes for Table 4-2

1. "Cool air" is air cooler than space temperature.
2. "Warm air" is air warmer than space temperature.
3. "Ceiling" includes any point above the breathing zone.
4. "Floor" includes any point below the breathing zone.
5. As an alternative to using the above values, determine *E_z* in accordance with ASHRAE Standard 129 for all air distribution configurations except unidirectional flow.

TABLE 4-3
System Ventilation Efficiency
 [ASHRAE 62.1:Table 6-3]

Max (<i>Z_p</i>)	<i>E_V</i>
< 0.15	1.0
< 0.25	0.9
< 0.35	0.8
< 0.45	0.7
< 0.55	0.6
> 0.55	Use ASHRAE 62.1, Appendix A

Notes for Table 4-3.

1. "Max *Z_p*" refers to the largest value of *Z_p*, calculated using Equation 4-5, among all the zones served by the system.
2. Interpolating between table values is permitted.

TABLE 4-4 Minimum Exhaust Rates
[ASHRAE 62.1:Table 6-4]

Occupancy Category ⁶	Exhaust Rate cfm/unit	Exhaust Rate cfm/ft ²	Exhaust Rate L/s-unit	Exhaust Rate L/s-m ²
Art classrooms	-	0.70	-	3.5
Auto repair rooms ¹	-	1.50	-	7.5
Barber shop	-	0.50	-	2.5
Beauty and nail salons	-	0.60	-	3.0
Cell with toilet	-	1.00	-	5.0
Darkrooms	-	1.00	-	5.0
Arena ²	-	0.50	-	2.5
Kitchen – commercial	-	0.70	-	3.5
Kitchenettes	-	0.30	-	1.5
Locker rooms	-	0.50	-	2.5
Locker/dressing rooms	-	0.25	-	1.25
Parking garages ^{3,7}	-	0.75	-	3.7
Janitor, trash, recycle	-	1.00	-	5.0
Pet shops (animal areas)	-	0.90	-	4.5
Copy, printing rooms	-	0.50	-	2.5
Science lab classrooms	-	1.00	-	5.0
Toilets – public ⁴	50/70	-	25/35	-
Toilet – private ⁵	25/50	-	12.5/25	-
Woodwork shop/classroom	-	0.50	-	2.5

Notes For Table 4-4

- ¹ Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.
- ² The rates do not include exhaust from vehicles or equipment with internal combustion engines.
- ³ Exhaust rate is not required for open parking garages as defined in accordance with the Building Code.
- ⁴ Rate is per water closet or urinal. Provide the higher rate where periods of heavy use are expected to occur, e.g., toilets in theatres, schools, and sports facilities.
- ⁵ Rate is for a toilet room intended to be occupied by one person at a time. For continuous system operation during normal hours of use, the lower rate may be used. Otherwise use the higher rate.
- ⁶ For unlisted occupancies for a proposed space not listed in the table, the requirements for the listed occupancy that is most similar in terms of occupant density and occupancy type shall be used.
- ⁷ Exhaust rate is not required for enclosed parking garages having a floor area of 1,000 square feet or less and used for the storage of 5 or less motorized vehicles.

CHAPTER 6

DUCT SYSTEMS

601.0 Scope.

601.1 Ducts and plenums that are portions of a heating, cooling, absorption or evaporative cooling, or product-conveying system shall comply with the requirements of this chapter.

601.2 Sizing Requirements. Duct systems used with blower-type equipment that are portions of a heating, cooling, absorption, evaporative cooling, or outdoor-air ventilation system shall be sized in accordance with Chapter 17, or by other approved methods.

Exception: [HCD 1] Duct sizing calculations are not required for existing duct systems.

602.0 Material.

602.1 General. Supply air, return air, and outside air for heating, cooling, or evaporative cooling systems shall be conducted through duct systems constructed of metal as set forth in Tables 6-1, 6-2, 6-3, 6-4, 6-7, 6-8, 6-9, and 6-10, or metal ducts complying with UMC Standard No. 6-2 or the referenced HVAC duct construction standard in Chapter 17. Rectangular ducts in excess of two (2) inches w.g. shall comply with UMC Standard No. 6-2 or the referenced HVAC duct construction standard in Chapter 17. Ducts, plenums, and fittings may be constructed of concrete, clay, or ceramics when installed in the ground or in a concrete slab, provided the joints are tightly sealed.

In other than high-rise buildings, Group A, E, H, I, L and R occupancies and other applications listed in Section 111 regulated by the Office of the State Fire Marshal, corridors shall not be used to convey air to or from rooms if the corridor is required to be of fire-resistive construction per the Building Code. In high-rise buildings, Group A, E, H, I, L and R occupancies and other applications listed in Section 111 regulated by the Office of the State Fire Marshal, corridors shall not be used to convey air to or from rooms except where permitted in accordance with Section 1017.4 of the California Building Code.

Exception [For OSHPD 1, 2, 3 & 4]: See Section 407.4.1.3.

Not permitted for [OSHPD 1, 2, 3 & 4] Concealed building spaces or independent construction within buildings may be used as ducts or plenums.

When gypsum products are exposed in ducts or plenums, the air temperature shall be restricted to a range from 50°F (10°C) to 125°F (52°C), and moisture content shall be controlled so that the material is not adversely affected. For the purpose of this section, gypsum products shall not be exposed in ducts serving as supply from evaporative coolers, and in

other air-handling systems regulated by this chapter when the temperature of the gypsum product will be below the dew point temperature.

See Chapter 8 for limitations on combustion products venting systems extending into or through ducts or plenums.

See Chapter 5 for limitations on environmental air systems exhaust ducts extending into or through ducts or plenums.

Exhaust ducts under positive pressure and venting systems shall not extend into or pass through ducts or plenums. For appliance vents and chimneys, see Chapter 8.

602.2 Combustibles Within Ducts or Plenums.

Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not greater than twenty-five (25) and a smoke developed index not greater than fifty (50), when tested as a composite product in accordance with one of the following test methods: NFPA 255, Method of Test of Surface Burning Characteristics of Building Materials, ASTM E84, Surface Burning Characteristics of Building Materials, or UL 723, Test for Surface Burning Characteristics of Building Materials, except as indicated below.

Exceptions:

- (1) Return-air and outside-air ducts, plenums, or concealed spaces that serve a dwelling unit shall be permitted to be of combustible construction.
- (2) Air filters meeting the requirements of Sections 312.0 and 503.3.
- (3) Water evaporation media in an evaporative cooler.
- (4) Charcoal filters when protected with an approved fire suppression system.
- (5) Electrical wiring in plenums shall comply with NFPA 70, National Electrical Code. Electrical wires and cables and optical fiber cables shall be listed and labeled as suitable for use in plenums and shall have a flame spread distance not greater than five (5) feet (1,524 mm), an average optical density not greater than 0.15, and a peak optical density not greater than 0.5, when tested in accordance with NFPA 262, Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- (6) Nonmetallic fire sprinkler piping in plenums shall be listed and labeled as suitable for use in plenums and shall have a flame spread

distance not greater than five (5) feet (1,524 mm), an average optical density not greater than 0.15 and, a peak optical density not greater than 0.5, when tested in accordance with UL 1887, Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

- (7) Nonmetallic pneumatic tubing in plenums shall be listed and labeled as suitable for use in plenums and shall have a flame spread distance not greater than five (5) feet (1,524mm), an average optical density not greater than 0.15, and a peak optical density not greater than 0.5, when tested in accordance with UL 1820, Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.
- (8) Loudspeakers and recessed lighting fixtures, including their assemblies and accessories, in plenums shall be listed and labeled as suitable for use in plenums and shall have a peak rate of heat release not greater than 100 kilowatts, an average optical density not greater than 0.15, and a peak optical density not greater than 0.5, when tested in accordance with UL 2043, Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.
- (9) Smoke detectors.
- (10) Duct insulation, coverings, and linings and other supplementary materials complying with 605.0.
- (11) Materials in a Group H, Division 6, fabrication area including the areas above and below the fabrication area sharing a common air recirculation path with the fabrication area.

602.3 Factory-Made Air Ducts. Factory-made air ducts shall be approved for the use intended or shall conform to the requirements of the referenced standard for air ducts in Chapter 17. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with the referenced standard for air ducts in Chapter 17 and its class designation. These ducts shall be listed and shall be installed in accordance with the terms of their listing and the requirements of UMC Standard No. 6-5. Flexible air connectors are not permitted.

602.3.1 Flexible Ducts. [For OSHPD 1, 2, 3 & 4] In hospital building projects and all other health-care facilities, including clinics and correctional treatment centers, flexible ducts of not more than 10

feet (3048 mm) in length may be used to connect supply, return or exhaust-air terminal devices to rigid duct systems. Where constant volume, variable volume or mixing boxes are utilized, flexible duct of not more than 10 feet (3048 mm), may be used on the inlet side for alignment. An internal impervious liner shall be provided to isolate insulation material from conditioned air.

602.4 Joints and Seams of Ducts. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other means.

Crimp joints for round ducts shall have a contact lap of at least 1-1/2 inch (38 mm) and shall be mechanically fastened by means of at least three (3) sheet-metal screws equally spaced around the joint, or an equivalent fastening method.

Joints and seams for 0.016 inch (0.41 mm) (No. 28 gauge) and 0.013 inch (0.33 mm) (No. 30 gauge) residential rectangular ducts shall be as specified in Table 6-1 for 0.019 inch (0.48 mm) (No. 26 gauge) material.

Joints and seams for rectangular duct systems shall be as specified in Table 6-1.

Joints and seams for flat oval ducts and round ducts in other than single-dwelling units shall be as specified in Table 6-8.

Joints and seams and all reinforcements for factory-made air ducts and plenums shall meet with the conditions of prior approval in accordance with the installation instructions that shall accompany the product. Closure systems for rigid air ducts and plenums shall be listed in accordance with UL 181A, Standard for Closure Systems for Use with Rigid Air Ducts and Air Connectors. Closure systems for flexible air ducts shall be listed in accordance with UL 181B, Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors.

602.5 Metal. Every duct, plenum, or fitting of metal shall comply with Table 6-1 or 6-8.

Exceptions:

- (1) Ducts, plenums, and fittings for systems serving single-dwelling units may comply with Table 6-9.
- (2) Duct systems complying with UMC Standard 6-2 or the referenced HVAC duct construction standard in Chapter 17, with prior approval, or duct systems complying with UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- (3) Duct systems complying with the UMC Standard 6-2 or the referenced HVAC duct

1016.0 Floors.

Boilers shall be mounted on floors of noncombustible construction unless listed for mounting on combustible flooring.

1017.0 Chimneys or Vents.

Boilers shall be connected to a chimney or vent, as provided for other fuel-burning equipment in Chapter 8 of this code.

1018.0 Drainage.

For heating or hot-water-supply boiler applications, the boiler room shall be equipped with a floor drain or other means suitable for disposing of the accumulation of liquid wastes incident to cleaning, recharging, and routine maintenance. No steam pipe shall be directly connected to any part of a plumbing or drainage system, nor shall any water having a temperature above 140°F (60°C) be discharged under pressure directly into any part of a drainage system. Pipes from boilers shall discharge by means of indirect waste piping, as determined by the Authority Having Jurisdiction or the boiler manufacturer's recommendations.

1019.0 Fuel Piping, Tanks, and Valves.

Tanks, piping, and valves for oil-burning appliances shall be installed in accordance with NFPA 31, Standard for the Installation of Oil-Burning Equipment. That portion of the oil-burning system supplied on boilers and covered within the scope of NFPA 85 shall be installed in accordance with NFPA 85.

1020.0 Air for Combustion and Ventilation.

Air for combustion and ventilation shall be provided in accordance with Chapter 7 of this code.

1021.0 Operating Adjustments and Instructions.

Hot water boiler installations, upon completion, shall have controls set, adjusted, and tested by the installing contractor. A complete control diagram of a permanent legible type, together with complete boiler operating instructions, shall be furnished by the installer for each installation.

1022.0 Inspections and Tests.

An installation for which a permit is required shall not be put into service until it has been inspected and approved by the Authority Having Jurisdiction.

It shall be the duty of the owner or his authorized representative to notify the Authority

Having Jurisdiction that the installation is ready for inspection and test. It also shall be the duty of the owner or his authorized representative to post in a conspicuous position on the installation a notice in substantially the following form: "Warning! This installation has not been inspected and approved by the Authority Having Jurisdiction and shall not be covered or concealed until so inspected and approved," and it shall be unlawful for anyone other than the Authority Having Jurisdiction to remove such notice. The Authority Having Jurisdiction shall require such tests as it deems necessary to determine that the installation complies with the provision of this section. Such tests shall be made by the owner or his authorized representative in the presence of the Authority Having Jurisdiction.

Exception: On installations designed and supervised by a registered professional engineer, the Authority Having Jurisdiction shall have the authority to permit inspection and testing by such engineer.

When the owner or his authorized representative requests inspection of a boiler prior to its installation, the Authority Having Jurisdiction shall make such inspection.

1023.0 Operating Permit.

It shall be unlawful to operate a boiler or pressure vessel without first obtaining a valid operating permit to do so from the Authority Having Jurisdiction. Such permit shall be displayed in a conspicuous place adjacent to the boiler or vessel. The operating permit shall not be issued until the equipment has been inspected and approved by the Authority Having Jurisdiction.

Exception: The operation only of steam-heating boilers, low-pressure hot-water-heating boilers, hot water supply boilers, and pressure vessels in Group R Occupancies of less than six dwelling units and in Group U Occupancies.

1024.0 Maintenance Inspection.

The Authority Having Jurisdiction shall inspect all boilers and pressure vessels operated under permit at such intervals as deemed necessary, but not less frequently than noted below:

1024.1 Power boilers and miniature boilers shall be inspected externally annually. Where construction and operating conditions permit, they shall, in addition, be subject to inspection internally annually.

1024.2 Steam-heating boilers and hot-water-heating boilers shall be inspected externally

annually. Where construction and operating conditions permit, they shall, in addition, be subject to inspection internally annually.

1024.3 Automatic steam-heating boilers shall be inspected externally biennially. Where construction and operating conditions permit, they shall, in addition, be subject to inspection internally biennially.

1024.4 Unfired pressure vessels shall be inspected externally biennially. When subject to corrosion and construction permits, they shall, in addition, be subject to inspection internally biennially.

Inspection of boilers and pressure vessels covered by insurance may be made by employees of the insuring company holding commissions from the National Board of Boiler and Pressure Vessel Inspectors, subject to approval of the Authority Having Jurisdiction. Approved insuring company inspectors shall make reports on prescribed forms on inspections authorized by the Authority Having Jurisdiction. The reports shall be filed in the Authority Having Jurisdiction office. Company inspectors shall notify the Authority Having Jurisdiction of suspension of insurance because of dangerous conditions, new insurance in effect, and discontinuance of insurance coverage.

1025.0 Operation and Maintenance of Boilers and Pressure Vessels.

Boilers and pressure vessels shall be operated and maintained in conformity with requirements for adequate protection of the public established by the Authority Having Jurisdiction in accordance with nationally recognized standards.

The Authority Having Jurisdiction shall notify the owner or authorized representative of defects or deficiencies that shall be promptly and properly corrected. If such corrections are not made, or if the operation of the boiler or pressure vessel is deemed unsafe by the Authority Having Jurisdiction, they shall have the authority to revoke the permit to operate the boiler or pressure vessel. If the operation of a boiler or pressure vessel is deemed by the Authority Having Jurisdiction to constitute an immediate danger, the pressure on such boiler or pressure vessel may be relieved at the owner’s cost and the boiler or pressure vessel shall not thereafter be operated without approval of the Authority Having Jurisdiction.

**TABLE 10-1
Expansion Tank Capacities for Gravity
Hot Water Systems**

Based on a two-pipe system with an average operating water temperature of 170°F (77°C), using cast-iron column radiation with a heat emission rate of 150 Btu per hour per square foot (473 W/m²) equivalent direct radiation.

Square Feet of Installed Expansion Direct Radiation¹ (x 0.0929 for m²)	Tank Capacity, Gallons (x 3.785 for L)
Up to 350	18
Up to 450	21
Up to 650	24
Up to 900	30
Up to 1,100	35
Up to 1,400	40
Up to 1,600	2 to 30
Up to 1,800	2 to 30
Up to 2,000	2 to 35
Up to 2,400	2 to 40

Note:

¹ For systems with more than 2,400 square feet (223 m²) of installed equivalent direct water radiation, the required capacity of the cushion tank shall be increased on the basis of 1 gallon (3.785 L) tank capacity per 33 square feet (3.07 m²) of additional equivalent direct radiation.

**TABLE 10-2
Expansion Tank Capacities for Forced
Hot Water Systems**

Based on an average operating water temperature of 195°F (90.6°C), a fill pressure of 12 psig (82.7 kPa), and a maximum operating pressure of 30 psig (206.8 kPa).

System Volume,¹ Gallons (x 3.785 for L)	Tank Capacity, Gallons (x 3.785 for L)
100	15
200	30
300	45
400	60
500	75
1,000	150
2,000	300

¹ Includes volume of water in boiler, radiation, and piping, not including expansion tank.

Table 11-1 (Continued)
Refrigerant Groups¹, Properties², and Allowable Quantities³

R-500	azeotrope	R-12/152a (73.8/26.2)	A1	1,000 ¹⁰	47,000 ¹⁰	12.00
73.8%	CCl ₂ F ₂	Dichlorodifluoromethane				
26.2%	CH ₃ CHF ₂	1,1-difluoroethane				
R-502	azeotrope	R-22/115(48.8/51.2)	A1	1,000 ¹⁰	65,000 ¹¹	19.00
48%	CHClF ₂	Chlorodifluoromethane				
51.2%	CClF ₂ CF ₃	1-chloro-1,1,2,2,2-pentafluoroethane				
R-503	azeotrope	R-23/13 (48.8/51.2)	A1	1,000	67,000	15.00
R-507A	azeotrope	R-125/143a (50/50)	A1	--	--	--
R-508A	azeotrope	R-23/116 (39/61)	A1	--	--	--
R-508B	azeotrope	R-23/116 (46/54)	A1	--	--	--
R509A	azeotrope	R-22/218 (44/56)	A1	--	--	--
R-600	CH ₃ CH ₂ CH ₂ CH ₃	Butane	A3	800	3,400	0.51
R-600a	CH(CH ₃) ₂ CH ₃	Isobutane (2-methyl propane)	A3	800	3,400	0.51
R-717	NH ₃	Ammonia	B2	5,012	500	0.022
R-718	H ₂ O	Water	A1	--	--	--
R-744	CO ₂	Carbon Dioxide	A1	5,000	50,000	5.70
R-1150	CH ₂ =CH ₂	Ethene (ethylene)	A3	1,000	5,200	0.38
R-1270	CH ₃ CH=CH ₂	Propene (propylene)	B3	1,000	3,400	0.37

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.0283m³.

¹ Refrigerant safety group designation is in accordance with Section 1102.0.

² Refrigerant properties are those needed for this chapter.

³ Allowable quantities are for high-probability systems under Section 1103.0 only.

⁴ Chemical name shown is the preferred name.

⁵ PEL is that designated in 29 CFR 1910.1000 unless otherwise indicated.

⁶ IDLH is that designated by NIOSH unless otherwise designated.

⁷ Pounds of refrigerant in a high-probability system per 1,000 cubic feet (28.3 kg/m³) of occupied space. See Section 1104.0. This column does not apply to refrigerant machinery rooms or areas covered by Section 1106.0.

⁸ The PEL value shown is the TLV-C recommended by ACGIH.

⁹ The IDLH value shown is reduced from that designated by NIOSH in light of cardiac sensitization potential.

¹⁰ A PEL has not yet been established; the value given was determined in a consistent manner.

¹¹ An IDLH has not yet been established; the value given was determined in a consistent manner.

¹² OSHA PEL is 50 ppm; ACGIH TLV-TWA is 25 ppm.

|| ¹³ **[For OSHPD 1, 2, 3 (Surgical Clinics) & 4]** The quantity of refrigerant in each system is limited to 50% of the amount listed. Exception: kitchens, laboratories, and mortuaries.

TABLE 11-2
Permissible Refrigeration Systems¹

Occupancy Group and Division	High-Probability System	Low-Probability System	Machinery Room
A-1	Group A1 only	Any	Any
A-2.1	Group A1 only	Any	Any
A-3	Group A1 only	Any	Any
A-4	Group A1 only	Any	Any
B	Group A1 only ²	Any	Any
E-1	Group A1 only	Any	Any
E-2	Group A1 only	Any	Any
E-3	Group A1 only	Any	Any
F-1	Group A1 only ²	Any	Any
F-2	Any ²	Any	Any
H-1	Any	Any	Any
H-2	Any	Any	Any
H-3	Any	Any	Any
H-4	Group A1 only	Any	Any
H-5	Group A1 only	Any	Any
H-6	Group A1 only	Any	Any
H-7	Any	Any	Any
[For OSHPD 1, 2, 3 & 4] I-1.1	None	Any	Any
I-1.2	Group A1 only	Any	Any
I-2	Group A1 only	Any	Any
[For OSHPD 1, 2, 3 & 4] I-3	None	Any	Any
M	Group A1 only ²	Any	Any
R-1	Group A1 only	Any	Any
R-2	Group A1 only	Any	Any
R-3	Group A1 only	Any	Any
S-1	Group A1 only ²	Any	Any
S-2	Any ²	Any	Any
S-3	Group A1 only	Any	Any
S-4	Group A1 only	Any	Any
S-5	Group A1 only	Any	Any
U-1	Any	Any	Any
U-2	N/A	N/A	N/A

Note: N/A—Not applicable.

¹See Section 1105.0.

²Any refrigerant may be used within a high-probability system when the room or space complies with Section 1105.3.

1201.2.5 Changes in Pipe Sizes. Where different sizes of pipe or pipe and fittings are to be connected, the proper size increasers or reducer fittings shall be used between the two sizes. When the branch is at least two sizes smaller than the main, weldolets or threadolets may be used in lieu of welding tees. Bushings shall not be used. Eccentric reducing fittings shall be used wherever necessary to provide free drainage of lines.

1201.2.6 Hangers and Supports. All piping and equipment shall be adequately supported to the satisfaction of the Authority Having Jurisdiction. Hot-water and steam piping shall be supported, anchored, and provided with swing joints, expansion loops or joints, or other means to avoid excessive strain on piping, equipment, or the building structure to the satisfaction of the Authority Having Jurisdiction. *[For OSHPD 1, 2 and 4] Pipe connections less than 2-1/2" to heating coils, cooling coils, humidifiers, and similar equipment shall have flexible connectors or three (3) 90-degree offsets in close proximity of the connection.*

1201.2.6.1 Vertical Piping—Attachment. Vertical piping and tubing shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents.

1201.2.6.2 Horizontal Piping.

1201.2.6.2.1 Supports. Horizontal piping and tubing shall be supported at sufficiently close intervals to keep it in alignment and prevent excessive sagging.

1201.2.6.2.2 In Ground. Piping and tubing in the ground shall be laid on a firm bed for its entire length except when otherwise approved by the Authority Having Jurisdiction. Asbestos-cement piping shall be provided with adequate thrust blocking.

1201.2.7 Installation.

1201.2.7.1 Same Materials Required. All piping materials used, except valves and similar devices, shall be of a like material, except as otherwise acceptable to the Authority Having Jurisdiction.

1201.2.7.2 Wall Thickness.

1201.2.7.2.1 Piping shall be at least standard-weight brass or copper, Class 150 cast iron, standard-weight wrought iron, ASTM Schedule 40 steel, or suitable asbestos-cement of adequate pressure rating.

1201.2.7.2.2 Tubing shall be at least Type K—for condensate return lines; Type L—for steam condenser cooling water lines, underground water lines, and aboveground water lines; Type M—for aboveground water lines not embedded in concrete or masonry.

1201.2.7.3 Piping Embedded in Structure.

Piping shall not be built into or embedded in concrete or masonry, except where used for radiant panel heating or cooling. Black steel pipe, wrought-iron piping, or Type L copper tubing may be so embedded.

1201.2.7.4 Cutting Structure. Structural members shall not be seriously weakened or impaired by cutting or notching.

1201.2.7.5 Providing for Expansion, Contraction, and Settling. Piping shall be installed so that piping, connections, and equipment shall not be subjected to excessive strains or stresses, and provisions shall be made for expansion, contraction, shrinkage, and structural settlement.

1201.2.7.6 Circulation. Piping shall provide adequate circulation. Piping shall be graded so that all gases can move in the direction of the water flow to a vented section of the system. When sections of a piping system cannot be installed with the required grade, such sections shall be provided with automatic or manual air vents whose discharge is piped to an approved location. Steam traps shall be provided where required.

1201.2.7.7 Underground Piping.

1201.2.7.7.1 Cinders and Other Corrosive Material Fills. All piping passing through or under cinders or other corrosive fill materials shall be suitably protected from corrosion.

Exception: Where a soil analysis by an acceptable testing laboratory shows the soil to be free of materials that may corrode the pipe to be installed, the requirements for protective coatings may be waived.

1201.2.7.7.2 Beneath Buildings. Piping installed within a building and in, or under, a concrete floor slab resting on the ground shall be installed as follows:

Ferrous Piping. Ferrous piping shall be galvanized and covered with an approved protective coating.

Copper Tubing. Copper tubing shall be installed without joints, where possible.

Asbestos-Cement. Asbestos-cement pipe shall not be installed beneath any building.

1201.2.7.7.3 Outside of Buildings.

Black Wrought Iron and Black Steel. Black wrought-iron and black steel piping shall be protected against corrosion by an approved pipe wrapping.

Asbestos-Cement. Asbestos-cement piping shall be installed in accordance with the manufacturer's recommendations, but shall not be installed within two (2) feet (610 mm) of any building.

1201.2.7.7.4 Under Walls or Foundations. Piping passing under walls or foundations shall be protected from breakage.

1201.2.7.7.5 Openings into Buildings. Voids around piping passing through concrete or masonry floors or walls shall be appropriately sealed at the opening into the building. Sleeves shall be provided at such openings.

1201.2.7.8 Aboveground Piping.

1201.2.7.8.1 Sleeves. Sleeves shall be provided to protect all piping through concrete and masonry walls.

1201.2.7.8.2 Insulation. The temperature of surfaces within normal reach of building occupants shall not exceed 140°F (60°C) unless they are protected by suitable insulation. Where sleeves are installed, any insulation shall continue full-sized through them.

1201.2.7.8.3 Lining. Combustible portions of unventilated spaces that contain piping or devices whose outside temperature, including insulation, exceeds 140°F (60°C), shall be lined with No. 24 gauge (0.021 inch) (0.53 mm) steel, or 1/4 inch thick (6.4 mm) insulating millboard.

1201.2.7.8.4 Clearance. There shall be at least one (1) inch (25.4 mm) clearance from the structure around steam pipes.

1201.2.7.8.5 Exposed Piping. Exposed piping subject to excessive corrosion, erosion, or mechanical damage shall be suitably protected.

1201.2.7.8.6 Asbestos-Cement Piping. Asbestos-cement piping shall not be installed within any building.

1201.2.7.8.7 Roof and Wall Openings.

Joints at the roof around pipes or appurtenances shall be made watertight by the use of approved flashings or flashing material. Exterior wall openings shall be made watertight.

1201.2.7.8.8 Drainage. Means shall be provided to drain all piping.

1201.2.7.8.9 Freezing. Where required, piping outside of a building or in an exterior wall shall be protected from freezing.

1201.2.7.9 Trenches and Tunnels.

1201.2.7.9.1 Protection of Structure. Trenches deeper than the footings of a building or structure and paralleling the same shall be at least 45 degrees therefrom, or approved per Section 105.0.

1201.2.7.9.2 Mechanical Equipment. Use of mechanical excavating equipment is prohibited within two (2) feet (610 mm) of existing piping or appurtenances.

1201.2.7.9.3 Tunneling and Driving. Tunnels shall, before backfilling, have a clear height of two (2) feet (609.6 mm) above the pipe and shall be limited in length to one-half the depth of the trench, with a maximum length of eight (8) feet (2,438.4 mm). When pipes are driven, the drive pipe shall be at least one size larger than the pipe to be laid.

1201.2.7.9.4 Backfilling. Excavations shall be completely backfilled as soon after inspection as practicable. Adequate precaution shall be taken to ensure proper compaction of backfill around piping without damage to such piping. Trenches shall be backfilled in thin layers to twelve (12) inches (304.8 mm) above the top of the piping with clean earth that shall not contain stones, boulders, cinderfill, or other materials that would damage, break the piping, or cause corrosive action. Mechanical devices, such as bulldozers, graders, etc., may then be used to complete backfill to grade. Fill shall be properly compacted. Suitable precautions shall be taken to ensure permanent stability for pipe laid in filled or made ground.

1201.2.8 Pressure Testing.

1201.2.8.1 Responsibility. The equipment, material, and labor necessary for

ASTM D 2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings, or ASTM D 2517, Reinforced Epoxy Resin Gas Pressure Pipe and Fittings, as well as the design pressure and design limitations of 49 CFR 192.123, and shall otherwise conform to the installation requirements thereof.

TABLE 13-42
Demand Factors for Use in Calculating Gas Piping Systems in Manufactured Home Communities

No. of Manufactured Homesites	Btu/h per Manufactured Homesite
1	125,000
2	117,000
3	104,000
4	96,000
5	92,000
6	87,000
7	83,000
8	81,000
9	79,000
10	77,000
11–20	66,000
21–30	62,000
31–40	58,000
41–60	55,000
Over 60	50,000

Note:

In extreme climate areas, additional capacities shall be considered.

1330.0 Gas Piping Installation.

1330.1 Minimum Burial Below Ground Level and Clearances. All gas piping installed below ground level shall have a minimum earth cover of eighteen (18) inches (451 mm) and shall be installed with at least twelve (12) inches (305 mm) of clearance in any direction from any other underground utility system.

1330.2 Metallic Gas Piping.

1330.2.1 All metallic gas piping systems shall be installed in accordance with approved plans and specifications, including provisions for cathodic protection. Each cathodic protection system shall be designed and installed to conform to the provisions of 49 CFR 192.

1330.2.2 Where the cathodic protection system is designed to protect only the gas piping

system, the gas piping system shall be electrically isolated from all other underground metallic systems or installations. Where only the gas piping system is cathodically protected against corrosion, a dielectric fitting shall be used in the manufactured home gas connection to insulate the manufactured home from the underground gas piping system.

1330.2.3 Where a cathodic protection system is designed to provide all underground metallic systems and installations with protection against corrosion, all such systems and installations shall be electrically bonded together and protected as a whole.

1330.3 Plastic Gas Piping. Plastic gas piping shall only be used underground and shall be installed with an electrically conductive wire for locating the pipe. The wire used to locate the plastic pipe shall be copper, not smaller in size than No. 18 AWG, with insulation approved for direct burial. Every portion of a plastic gas piping system consisting of metallic pipe shall be cathodically protected against corrosion.

1330.4 Gas Piping System Shutoff Valve. A readily accessible and identifiable shutoff valve controlling the flow of gas to the entire manufactured home community gas piping system shall be installed near the point of connection to the service piping or to the supply connection of an LP-Gas container.

1331.0 Liquefied Petroleum Gas Equipment.

LP-Gas equipment shall be installed in accordance with the applicable provisions of NFPA 58, Liquefied Petroleum Gas Code.

1332.0 Oil Supply.

The following three methods of supplying oil to an individual manufactured homesite shall be permitted:

- (1) Supply from an outside underground tank (see Section 1333.6).
- (2) Supply from a centralized oil distribution system designed and installed in accordance with accepted engineering practices and in compliance with NFPA 31, Standard for the Installation of Oil-Burning Equipment.
- (3) Supply from an outside aboveground tank (see Section 1333.6).

1332.1 Minimum Oil Supply Tank Size. Oil supply tanks shall have a minimum capacity equal to 20 percent of the average annual oil consumption.

1332.2 Oil Supply Connections – General. Oil supply connections at manufactured home stands, where provided from a centralized oil distribution system, shall be located and arranged to permit attachment in a worklike manner to a manufactured home utilizing the stand. The installation of such facilities shall meet the provisions of NFPA 31, Standard for the Installation of Oil-Burning Equipment, and particularly Section 3.8 thereof.

1333.0 Fuel Supply Systems Installation.

1333.1 Flexible Gas Connector. Each gas supply connector shall be listed for outside manufactured home use, shall be not more than six (6) feet (1.83 m) in length, and shall have a capacity rating adequate to supply the connected load.

Exception: All gas supply connections for manufactured homes located on an all-weather wood, concrete, or concrete block foundation system or on a foundation constructed in accordance with the local building code or, in the absence of a local code, with a recognized model building code.

1333.2 Use of Approved Pipe and Fittings of Extension. Where it is necessary to extend the manufactured home inlet to permit connection of the six (6) foot (1.83 m) listed connector to the site gas outlet, the extension shall be of approved materials of the same size as the manufactured home inlet and shall be adequately supported at no more than four (4) foot (1.22 m) intervals to the manufactured home.

1333.3 Mechanical Protection. All gas outlet risers, regulators, meters, valves, or other exposed equipment shall be protected against accidental damage.

1333.4 Special Rules on Atmospherically Controlled Regulators. Atmospherically controlled regulators shall be installed in such a manner that moisture cannot enter the regulator vent and accumulate above the diaphragm. Where the regulator vent is obstructed due to snow and icing conditions, shields, hoods, or other suitable devices shall be provided to guard against closing of the vent opening.

1333.5 Fuel-Gas Piping Test. The manufactured home fuel-gas piping system shall be tested only with air before it is connected to the gas supply. The manufactured home gas piping system shall be subjected to a pressure test with all appliance shutoff valves in their closed positions.

1333.5.1 The fuel-gas piping test shall consist of air pressure at not less than ten (10) inches water column or more than fourteen (14) inches water column (6 oz./in.² to 8 oz./in.² [2,490 Pa to 3,486

Pa]). The system shall be isolated from the air pressure source and shall maintain this pressure for not less than ten (10) minutes without perceptible leakage. Upon satisfactory completion of the test, the appliance valves shall be opened, and the gas appliance connectors shall be tested with soapy water or bubble solution while under the pressure remaining in the piping system. Solutions used for testing for leakage shall not contain corrosive chemicals. Pressure shall be measured with either a manometer, slope gauge, or gauge that is calibrated in either water inches or psi with increments of either 1/10 inch (2.5 mm) or 1/10 psi (0.6 kPa gauge), as applicable. Upon satisfactory completion of the test, the manufactured home gas supply connector shall be installed, and the connections shall be tested with soapy water or bubble solution.

WARNING

Do not overpressurize the fuel-gas piping system. Damage to valves, regulators, and appliances can occur due to pressurization beyond the maximums specified.

1333.5.2 Gas appliance vents shall be visually inspected to ensure that they have not been dislodged in transit and are connected securely to the appliance.

1333.6 Oil Tanks.

No more than one 660 gallon (2,500 L) tank or two tanks with aggregate capacity of 660 gallons (2,500 L) or less shall be connected to one oil-burning appliance. Two supply tanks, where used, shall be cross-connected and provided with a single fill and single vent, as described in NFPA 31, Standard for the Installation of Oil-Burning Equipment, and shall be on a common slab and rigidly secured, one to the other. Tanks having a capacity of 660 gallons (2,500 L) or less shall be securely supported by rigid, noncombustible supports to prevent settling, sliding, or lifting.

1333.6.1 Oil supply tanks shall be installed in accordance with the applicable provisions of NFPA 31, Standard for the Installation of Oil-Burning Equipment.

1333.6.2 A tank with a capacity no larger than 60 gallons (230 L) shall be permitted to be a DOT-5 shipping container (drum) and so marked, or a tank meeting the provisions of UL 80, Steel Inside Tank for Oil Burner Fuel. Tanks other than DOT-5 shipping containers having a capacity of not more than 660 gallons (2500 L)

HISTORY NOTE APPENDIX

California Mechanical Code (Title 24, Part 4, California Code of Regulations)

For prior history, see the History Note Appendix to the California Mechanical Code, 2001 Triennial Edition effective November 1, 2002.

1. (BSC 04/06, DSA-AC 05/06, DSA-SS 05/06, HCD 06/06, OSHPD 06/06, SFM 02/06) Adoption by reference of the 2006 Uniform Mechanical Code (UMC) with necessary state amendments and repeal of the 2000 edition of the UMC. Filed with the Secretary of State on February 15, 2007 and February 21, 2007; effective on January 1, 2008.

2. (SFM 02/07 and OSHPD 05/07)
Amendments to Chapters 2, 3, 4, 6, 11 and 12; filed with the Secretary of State on September 12, 2008 and effective August 1, 2009. Errata changes to Sections 418.5, Table 4-4, 1018, Table 11-2 and Table 13-42.

