

**REVISION RECORD
FOR THE STATE OF CALIFORNIA
SUPPLEMENT**

July 1, 2024

2022 Title 24, Part 4, CALIFORNIA MECHANICAL CODE

General Information:

1. The date of this Supplement is for identification purposes only. See the History Note Appendix on the backside or accompanying page.
2. This supplement is issued by the California Building Standards Commission in order to provide new and/or replacement pages containing recently adopted provisions for the 2022 California Mechanical Code, California Code of Regulations, Title 24, Part 4. Instructions are provided below.
3. Health and Safety Code Section 18938.5 establishes that only building standards in effect at the time of the application for a building permit may be applied to the project plans and construction. This rule applies to both adoptions of building standards for Title 24 by the California Building Standards Commission, and local adoptions and ordinances imposing building standards. The new building standards provided with the enclosed blue supplement pages must not be enforced before the effective date.
4. Not all code text on the enclosed blue supplement pages is a new building standard. New, amended, or repealed building standards are identified by margin symbols. An explanation of margin symbols is provided in the code before the Table of Contents.
5. You may wish to retain the superseded material with this revision record so that the prior wording of any section can be easily ascertained.

Title 24, Part 4

Remove Existing Pages

iii – vi
xxiii – xlii
13 – 18
27 – 28
39 – 46
51 – 52
55 – 58
63 – 64
69 – 80
121 – 122
129 – 130

Insert Blue-Colored Pages

iii – vi
xxiii – xlii
13 – 18
27 – 28
39 – 46
51 – 52
55 – 58
63 – 64
69 – 80
121 – 122
129 – 130

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**2022 Title 24, Part 4, CALIFORNIA MECHANICAL CODE
(continued)**

Remove Existing Pages	Insert Blue-Colored Pages
213 – 238	213 – 238
	238.1 – 238.4
255 – 258	255 – 258
321 – 324	321 – 324
327 – 328	327 – 328
333 – 336	333 – 336
339 – 340	339 – 340
517 – 518	517 – 518
521 – 524	521 – 524
527 – 536	527 – 536

PREFACE

This document is Part 4 of thirteen parts of the official triennial compilation and publication of the adoptions, amendments and repeal of administrative regulations to *California Code of Regulations, Title 24*, also referred to as the *California Building Standards Code*. Part 4 is known as the *California Mechanical Code* and incorporates, by adoption, the 2021 edition of the *Uniform Mechanical Code* of the International Association of Plumbing and Mechanical Officials with the California amendments.

The *California Building Standards Code* is published in its entirety every three years by order of the California legislature, with supplements published in intervening years. The California legislature delegated authority to various state agencies, boards, commissions and departments to create building regulations to implement the State's statutes. These building regulations or standards, have the same force of law, and take effect 180 days after their publication unless otherwise stipulated. The *California Building Standards Code* applies to occupancies in the State of California as annotated.

A city, county, or city and county may establish more restrictive building standards reasonably necessary because of local climatic, geological or topographical conditions. Findings of the local condition(s) and the adopted local building standard(s) must be filed with the California Building Standards Commission to become effective and may not be effective sooner than the effective date of this edition of the *California Building Standards Code*. Local building standards that were adopted and applicable to previous editions of the *California Building Standards Code* do not apply to this edition without appropriate adoption and the required filing.

Should you find publication (e.g., typographical) errors or inconsistencies in this code or wish to offer comments toward improving its format, please address your comments to:

California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833-2936
Phone: (916) 263-0916
Web Page: www.dgs.ca.gov/bsc
Email: cbsc@dgs.ca.gov

ACKNOWLEDGEMENTS

The 2022 *California Mechanical Code* (Code) was developed through the outstanding collaborative efforts of the Department of Housing and Community Development, Division of State Architect, Office of the State Fire Marshal, Office of Statewide Health Planning and Development, California Energy Commission, California Department of Public Health, California State Lands Commission, Board of State and Community Corrections, and the California Building Standards Commission (Commission).

This collaborative effort included the assistance of the Commission's Code Advisory Committees and many other volunteers who worked tirelessly to assist the Commission in the production of this Code.

Governor Gavin Newsom

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<i>Aaron Stockwell</i>	<i>Laura Rambin</i>
<i>Juvilyn Alegre</i>	

Mia Marvelli – Executive Director
Michael L. Nearman – Deputy Executive Director

For questions on California state agency amendments, please refer to the contact list on page iv.

California Code of Regulations Title 24

California Agency Information Contact List

The following state agencies may propose building standards for publication in Title 24. Request notice of such activity with each agency of interest. See Sections 1.2.0 through 1.14.0 of the California Mechanical Code (Part 4 of Title 24) for more detailed information on the regulatory jurisdiction of each state agency.

Board of State and Community Corrections

www.bscc.ca.gov(916) 445-5073
Local Adult and Juvenile
Detention Facility Standards

California Building Standards Commission

www.dgs.ca.gov/bsc(916) 263-0916
State Buildings including UC and
CSU Buildings, Parking Lot and Walkway
Lighting, Green Building Standards
for Non-residential Buildings

California Energy Commission

www.energy.ca.gov**Energy Hotline** (800) 772-3300
Building Efficiency Standards
Appliance Efficiency Standards
Compliance Manual/Forms

California State Lands Commission

www.slc.ca.gov(562) 499-6312
Marine Oil Terminals Standards

California State Library

www.library.ca.gov(916) 323-9843

Department of Consumer Affairs:

Acupuncture Board

www.acupuncture.ca.gov(916) 515-5200
Office Standards

Board of Pharmacy

www.pharmacy.ca.gov(916) 518-3100
Pharmacy Standards

Bureau of Barbering and Cosmetology

www.barbercosmo.ca.gov(800) 952-5210
Barber and Beauty Shop,
and College Standards

Bureau of Household Goods and Services

www.bhgs.dca.ca.gov(916) 999-2041
Insulation Testing Standards

Structural Pest Control Board

www.pestboard.ca.gov(800) 737-8188
Structural Standards

Veterinary Medical Board

www.vmb.ca.gov(916) 515-5220
Veterinary Hospital Standards

Department of Food and Agriculture

www.cdffa.ca.gov
Meat & Poultry Packing Plant Standards
Rendering & Collection Center Standards(916) 900-5004
Dairy Standards(916) 900-5008

Department of Housing and Community Development

www.hcd.ca.govContact Center (800) 952-8356
Option 5 > Option 2
Residential - Hotels, Motels, Apartments,
Single-Family Dwellings; and
Permanent Structures in Mobilehome &
Special Occupancy Parks
Option 5 > Option 3
Manufactured Housing & Commercial Modular
Option 5 > Option 4
Factory-Built Housing
Option 5 > Option 5
Employee Housing Standards
Northern CA—Option 2 > Option 2 or 3
Southern CA—Option 2 > Option 4 or 5
Mobilehome - Permits & Inspections

Department of Public Health

www.dph.ca.gov(916) 449-5661
Organized Camps Standards
Public Swimming Pools Standards

Department of Water Resources

www.water.ca.govDWRwebComment@water.ca.gov
Recycled Water Building Standards

Division of the State Architect

www.dgs.ca.gov/dsa(916) 445-8100

Access Compliance

Fire and Life Safety

Structural Safety

Sustainability

Public Schools Standards
Essential Services Building Standards
Community College Standards

State Historical Building Safety Board

Historical Rehabilitation, Preservation,
Restoration or Relocation Standards

California Code of Regulations Title 24
California Agency Information Contact List (continued)

Office of Statewide Health Planning and Development/
|| California Department of Health Care Access and
Information (HCAI)

www.hcai.ca.gov(916) 440-8300
Hospital Standards
Skilled Nursing Facility Standards &
Clinic Standards

Office of the State Fire Marshal

www.osfm.fire.ca.gov(916) 568-3800
Code Development and Analysis
Fire Safety Standards

How to Distinguish Between Model Code Language and California Amendments

To distinguish between model code language and the incorporated California amendments, including exclusive California standards, California amendments will appear in italic font print.

[BSC] This is an example of a state agency acronym used to identify an adoption or amendment by the agency. The acronyms will appear at California Amendments and in the Matrix Adoption Tables. Sections 1.2.0 through 1.14.0 in Chapter 1, Division 1 of this code, explain the used acronyms, the application of state agency adoptions to building occupancies or building features, the enforcement agency as designated by state law (may be the state adopting agency or local building or fire official), the authority in state law for the state agency to make the adoption, and the specific state law being implemented by the agency's adoption. The following acronyms are used in Title 24 to identify the state adopting agency making an adoption.

Legend of Acronyms of Adopting State Agencies

BSC	California Building Standards Commission (see Section 1.2.0)
BSC-CG	California Building Standards Commission-CALGreen (see Section 1.2.3)
BSCC	Board of State and Community Corrections (see Section 1.3.0)
SFM	Office of the State Fire Marshal (see Section 1.11.0)
HCD-1	Department of Housing and Community Development (see Section 1.8.2.1.1)
HCD-2	Department of Housing and Community Development (see Section 1.8.2.1.3)
HCD-1/AC	Department of Housing and Community Development (see Section 1.8.2.1.2)
DSA-AC	Division of the State Architect-Access Compliance (see Section 1.9.1)
DSA-SS	Division of the State Architect-Structural Safety (see Section 1.9.2)
DSA-SS/CC	Division of the State Architect-Structural Safety/Community Colleges (see Section 1.9.2.2)
OSHPD 1	Office of Statewide Health Planning and Development (see Section 1.10.1)
OSHPD 1R	Office of Statewide Health Planning and Development (see Section 1.10.1)
OSHPD 2	Office of Statewide Health Planning and Development (see Section 1.10.2)
OSHPD 3	Office of Statewide Health Planning and Development (see Section 1.10.3)
OSHPD 4	Office of Statewide Health Planning and Development (see Section 1.10.4)
OSHPD 5	Office of Statewide Health Planning and Development (see Section 1.10.5)
DPH	Department of Public Health (see Section 1.7.0)
AGR	Department of Food and Agriculture (see Section 1.6.0)
CEC	California Energy Commission (see Section 100 in Part 6, the California Energy Code)
CA	Department of Consumer Affairs (see Section 1.6.0): Board of Barbering and Cosmetology Board of Examiners in Veterinary Medicine Board of Pharmacy Acupuncture Board Bureau of Home Furnishings Structural Pest Control Board SPCB
SL	State Library (see Section 1.12.0)
SLC	State Lands Commission (see Section 1.14.0)
DWR	Department of Water Resources (see Section 1.13.0 of Chapter 1 of the California Plumbing Code in Part 5 of Title 24)

The state agencies are available to answer questions about their adoptions. Contact information is provided on page iv of this code.

To learn more about the use of this code refer to the following pages. Training materials on the application and use of this code are available at the website of the California Building Standards Commission www.dgs.ca.gov/bsc.

RELATED PUBLICATIONS AND SERVICES

The Documents Listed are Not by this Reference Adopted by The State of California.

IAPMO Installation Standards:

IAPMO standards committees have formulated installation standards for a wide variety of commonly used plumbing materials and systems. The IAPMO installation standards are included after the text of the Uniform Plumbing Code, or can be purchased separately.

Material and Property Standards:

IAPMO does not generally develop material and property standards, but when a need exists the Association will take a leadership role by filling the void. They are available, are subject to amendments and are withdrawn when recognized consensus standards are formulated.

OFFICIAL Magazine:

IAPMO's bimonthly publication features informative articles related to Plumbing and Mechanical HVACR installations, award winning general interest features, technical columns and industry updates. Subscriptions are available and all IAPMO members receive a free copy of every issue!

Membership in IAPMO:

IAPMO membership is open to all interested persons. Membership categories include Student, Individual, Senior, Organizational and Governmental. Member benefits include discounted prices on IAPMO publications, a subscription to Official magazine, and numerous educational and training opportunities.

HOW TO CONTACT IAPMO

Mailing Address: 4755 East Philadelphia Street, Ontario, California 91761-2816

Main Number: 909-472-4100 • **Publication Orders:** 800-85-IAPMO • **Publication Fax:** 877-85-CODES

Website: www.iapmo.org • **Office Hours:** Monday – Friday, 8am – 5pm Pacific Time

TABLE OF CONTENTS

CHAPTER 1	DIVISION I		
	CALIFORNIA ADMINISTRATION1	1.8.8	<i>Appeals Board</i>11
1.1.0	<i>General</i>3	1.8.9	<i>Unsafe Buildings or Structures</i>11
1.1.1	<i>Title</i>3	1.8.10	<i>Other Building Regulations</i>12
1.1.2	<i>Purpose</i>3	1.9.0	<i>Division of the State Architect</i>12
1.1.3	<i>Scope</i>3	1.9.1	<i>Reserved for the Division of the State</i>
1.1.4	<i>Appendices</i>4	1.9.2	<i>Architect – Access Compliance</i>12
1.1.5	<i>Referenced Codes</i>4		<i>Division of the State Architect –</i>
1.1.6	<i>NonBuilding Standards, Orders,</i>	1.10.0	<i>Structural Safety</i>12
	<i>and Regulations</i>4		<i>Office of Statewide Health</i>
1.1.7	<i>Order of Precedence and Use</i>4	1.10.1	<i>Planning and Development</i>13
1.1.8	<i>City, County, or City and County</i>	1.10.2	<i>OSHPD 1 and OSHPD 1R</i>13
	<i>Amendments, Additions or</i>	1.10.3	<i>OSHPD 2</i>13
	<i>Deletions</i>5	1.10.4	<i>OSHPD 3</i>13
1.1.9	<i>Effective Date of This Code</i>5	1.10.5	<i>OSHPD 4</i>13
1.1.10	<i>Availability of Codes</i>5	1.11.0	<i>OSHPD 5</i>14
1.1.11	<i>Format</i>5	1.11.1	<i>Office of the State Fire Marshal</i>14
1.1.12	<i>Validity</i>5		<i>SFM – Office of the State</i>
1.2.0	<i>Building Standards Commission</i>5	1.11.2	<i>Fire Marshal</i>14
1.2.1	<i>BSC</i>5		<i>Duties and Powers of the</i>
1.2.2	<i>BSC-CG</i>6	1.11.3	<i>Enforcing Agency</i>15
1.2.3	<i>Alternative Materials, Design,</i>	1.11.4	<i>Construction Documents</i>17
	<i>and Methods of Construction</i>	1.11.5	<i>Fees</i>18
	<i>and Equipment</i>6	1.11.6	<i>Inspections</i>18
1.3.0	<i>Reserved for Corrections Standards</i>	1.11.7	<i>Certificate of Occupancy</i>18
	<i>Authority</i>7	1.11.8	<i>Temporary Structures and Uses</i>18
1.4.0	<i>Department of Consumer Affairs</i>7	1.11.9	<i>Service Utilities</i>18
1.4.2	<i>Adopting Agency Identification</i>7	1.11.10	<i>Stop Work Order</i>18
1.5.0	<i>Reserved for California Energy</i>		<i>Unsafe Buildings, Structures,</i>
	<i>Commission</i>7	1.11.11	<i>and Equipment</i>18
1.6.0	<i>Reserved for Department of</i>	1.12.0	<i>Adopting Agency Identification</i>18
	<i>Food and Agriculture</i>7	1.13.0	<i>Reserved for the State Librarian</i>18
1.7.0	<i>California Department of</i>		<i>Reserved for the Department</i>
	<i>Public Health</i>7	1.14.0	<i>of Water Resources</i>18
1.7.2	<i>Adopting Agency Identification</i>7		<i>Reserved for the State Lands</i>
1.8.0	<i>Department of Housing and</i>		<i>Commission</i>18
	<i>Community Development [HCD]</i>7	CHAPTER 1	DIVISION II
1.8.1	<i>Purpose</i>7		ADMINISTRATION19
1.8.2	<i>Authority and Abbreviations</i>7	101.0	<i>General</i>19
1.8.3	<i>Local Enforcing Agency</i>8	101.1	<i>Title</i>19
1.8.4	<i>Permits, Fees, Applications,</i>	101.2	<i>Scope</i>19
	<i>and Inspections</i>9	101.3	<i>Purpose</i>19
1.8.5	<i>Right of Entry for Enforcement</i>9	101.4	<i>Unconstitutional</i>19
1.8.6	<i>Local Modification by Ordinance</i>	101.5	<i>Validity</i>19
	<i>or Regulation</i>10	102.0	<i>Applicability</i>19
1.8.7	<i>Alternate Materials, Designs, Tests,</i>	102.1	<i>Conflicts Between Codes</i>19
	<i>and Methods of Construction</i>10	102.2	<i>Existing Installations</i>19

TABLE OF CONTENTS

102.3	Maintenance	19	301.4	Electrical Connections	47
102.4	Additions, Alterations, Renovations, or Repairs	19	301.5	Oil-Burning Appliances	47
102.5	Health and Safety	19	301.6	Personnel Protection	47
102.6	Changes in Building Occupancy . .	19	301.7	OSHPD 1R	47
102.7	Moved Structures	19	302.0	Materials – Standards and Alternates	47
102.8	Appendices	19	302.1	Minimum Standards	47
103.0	Duties and Powers of the Authority Having Jurisdiction	20	302.2	Alternate Materials and Methods of Construction Equivalency	47
103.1	General	20	302.3	Alternative Engineered Design . . .	48
103.2	Liability	20	303.0	Installation	48
103.3	Applications and Permits	20	303.1	Listed Appliances	48
103.4	Right of Entry	20	303.2	Closet or Alcove Installations	48
104.0	Permits	20	303.3	Unlisted Appliances	48
104.1	Permits Required	20	303.4	Anchorage of Appliances	48
104.2	Exempt Work	20	303.5	Movement	49
104.3	Application for Permit	20	303.6	Identification of Equipment	49
104.4	Permit Issuance	21	303.7	Liquefied Petroleum Gas Facilities .	49
104.5	Fees	22	303.8	Appliances on Roofs	49
105.0	Inspections and Testing	22	303.9	Avoiding Strain on Gas Piping . . .	49
105.1	General	22	303.10	Clearances	49
105.2	Required Inspections	22	303.11	Installation in Commercial Garages	50
105.3	Testing of Systems	23	303.12	Installation in Aircraft Hangars . . .	50
105.4	Connection to Service Utilities . . .	23	304.0	Accessibility for Service	50
106.0	Violations and Penalties	23	304.1	General	50
106.1	General	23	304.2	Sloped Roof	50
106.2	Notices of Correction or Violation .	23	304.3	Access to Appliances on Roofs . . .	50
106.3	Penalties	24	304.4	Appliances in Attics and Under-Floor Spaces	50
106.4	Stop Orders	24	305.0	Location	51
106.5	Authority to Disconnect Utilities in Emergencies	24	305.1	Installation in Residential Garages	51
106.6	Authority to Condemn	24	305.2	Pit Location	51
107.0	Board of Appeals	24	305.3	Flood Hazard Areas	51
107.1	General	24	305.4	Elevator Shaft	51
107.2	Limitations of Authority	24	305.5	Drainage Pan	51
Table 104.5	Mechanical Permit Fees	25	306.0	Automatic Control Devices	51
			306.1	General	51
CHAPTER 2	DEFINITIONS	27	306.2	<i>Building Automation Systems</i> . . .	51
201.0	General	29	307.0	Labeling	52
201.1	Applicability	29	307.1	Fuel-Burning Appliances	52
202.0	Definition of Terms	29	307.2	Electric Heating Appliances	52
202.1	General	29	307.3	Heat Pump and Electric Cooling Appliances	52
CHAPTER 3	GENERAL REGULATIONS	45	307.4	Absorption Units	52
301.0	General	47	308.0	Improper Location	52
301.1	Applicability	47	308.1	General	52
301.2	Approval	47	309.0	<i>Workmanship</i>	52
301.3	Design of Equipment	47	309.1	<i>Engineering Practices</i>	52

309.2	Concealing Imperfections	52	316.9	Structural Members	55
309.3	Installation Practices	52	316.10	Rodentproofing	55
310.0	Condensate Wastes and Control	52	316.11	Metal Collars	55
310.1	Condensate Disposal	52	317.0	Trenching, Excavation, and Backfill	55
310.2	Condensate Control	53	317.1	Trenches	55
310.3	Condensate Waste Pipe Material and Sizing	53	317.2	Tunneling and Driving	55
Table 310.3	Minimum Condensate Pipe Size	53	317.3	Open Trenches	56
310.4	Appliance Condensate Drains	53	317.4	Excavations	56
310.5	Point of Discharge	53	318.0	<i>Scope</i>	56
310.6	Condensate Waste From Air-Conditioning Coils	53	318.1	<i>Applicability</i>	56
310.7	Plastic Fittings	53	318.2	<i>Services/Systems and Utilities</i>	56
311.0	Heating or Cooling Air System	53	319.0	<i>Steam and Hot-Water Systems</i>	56
311.1	Source	53	319.1	<i>Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers</i>	56
311.2	Air Filters	54	319.2	<i>Requirements for Skilled Nursing, Intermediate Care Facilities and Basic Services Provided in Correctional Treatment Centers</i>	56
311.3	Prohibited Source	54	320.0	<i>Air Conditioning and Heating Systems</i>	56
311.4	Return-Air Limitations	54	320.1	<i>Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers</i>	56
311.5	<i>California Energy Code Requirements for Residential Air Filtration</i>	54	320.2	<i>Requirements for Skilled Nursing, Intermediate Care Facilities and Basic Services Provided in Correctional Treatment Centers</i>	56
312.0	Plumbing Connections	54	320.3	<i>Requirements for Outpatient Facilities and Licensed Clinics</i>	57
312.1	General	54	320.4	<i>Telephone and Technology Equipment Centers</i>	57
313.0	Hangers and Supports	54	320.5	<i>Psychiatric Services</i>	57
313.1	General	54	321.0	<i>Essential Mechanical Provisions</i>	57
313.2	Material	54	322.0	<i>Sensitive Areas or Rooms</i>	57
313.3	Suspended Piping	54	323.0	<i>Mechanical Equipment Schedules</i>	57
313.4	Alignment	54	324.0	<i>Diesel-powered Emergency Generators</i>	57
313.5	Underground Installation	54	325.0	<i>Alternate Source of Power for Safe Temperatures</i>	57
313.6	Hanger Rod Sizes	54	Table 303.10.1	Reduction of Clearances with Specified Forms of Protection	58
Table 313.6	Hanger Rod Sizes	54	Table 313.3	Hangers and Supports	60
313.7	Gas Piping	54			
314.0	Balancing	55			
314.1	General	55			
315.0	Louvers in Hurricane Prone Regions	55			
315.1	General	55			
316.0	Protection of Piping, Tubing, Materials, and Structures	55			
316.1	General	55			
316.2	Installation	55			
316.3	Corrosion, Erosion, and Mechanical Damage	55			
316.4	Protectively Coated Pipe	55			
316.5	Fire-Resistant Construction	55			
316.6	Steel Nail Plates	55			
316.7	Sleeves	55			
316.8	Firewalls	55			

TABLE OF CONTENTS

CHAPTER 4	VENTILATION AIR	61		
401.0	General	63	408.4	<i>Filters for Outpatient Facilities</i>71
401.1	Applicability	63	409.0	<i>Ducts</i>71
401.2	<i>Filters</i>	63	409.3	<i>Insulation of Ducts</i>71
402.0	Ventilation Air	63	410.0	<i>Laboratory Ventilating</i>
402.1	Occupiable Spaces	63	410.1	<i>Systems and Hoods</i>71
402.2	Natural Ventilation	63	410.2	<i>Laboratory Ventilating Systems</i>71
402.3	Mechanical Ventilation	64		<i>Exhaust Hoods and</i>
402.4	Outdoor Air Intake Protection	64	410.3	<i>Safety Cabinets</i>71
403.0	Ventilation Rates	64	411.0	<i>Laboratory Fume Hoods</i>71
403.1	General	64	412.0	<i>Kitchen and Dining Areas</i>71
403.2	Zone Calculations	64		<i>Boiler, Mechanical, and</i>
403.3	Single-Zone Systems	65	413.0	<i>Electrical Rooms</i>71
403.4	One Hundred Percent Outdoor		414.0	<i>Odorous Rooms</i>72
	Air Systems	65		<i>Airborne Infection Isolation</i>
403.5	Multiple-Zone Recirculating		414.1	<i>Rooms</i>72
	Systems	65	414.2	<i>Exhaust Systems</i>72
403.6	Design for Varying Operating		415.0	<i>Air Distribution</i>72
	Conditions	65	415.1	<i>Protective Environment Rooms</i>72
403.7	Exhaust Ventilation	66	416.0	<i>Air Distribution</i>72
403.8	Dynamic Reset	66		<i>Alarms – Airborne Infection</i>
403.9	Air Classification and			<i>Isolation Rooms and Protective</i>
	Recirculation	66	417.0	<i>Environment Rooms</i>72
404.0	Alternative Procedure for			<i>Testing and Balancing Airborne</i>
	Multiple-Zone Systems		418.0	<i>Infection Isolation Rooms and</i>
	Ventilation Efficiency	67		<i>Protective Environment Rooms</i>73
404.1	General	67		<i>Design Requirements for</i>
404.2	Average Outdoor Air Fraction	67	418.1	<i>Ethylene Oxide (ETO)</i>
404.3	Zone Ventilation Efficiency	67	418.2	<i>Sterilization Areas</i>73
405.0	Indoor Air Quality for Residential		418.3	<i>Air Changes</i>73
	Occupancies	68	418.4	<i>Exhaust Requirements</i>73
405.1	General	68	418.5	<i>Ventilation Requirements</i>73
405.2	Ventilation Air Rate	68	419.0	<i>Gas Valves</i>73
405.3	Bathroom Exhaust	68	419.1	<i>Alarm Systems</i>73
405.4	Kitchen Exhaust	68	419.2	<i>Neonatal Intensive Care Units</i>73
405.5	Ventilation Openings	68	420.0	<i>Formula Preparation Area</i>73
406.0	<i>Evaporative Cooling System</i>			<i>Treatment Area/Room</i>73
	<i>for Health Care Facilities</i>	68	Table 4-A	<i>Air Distribution Devices</i>73
407.0	Ventilation System Details	68		<i>Pressure Relationship and</i>
407.1	General	68		<i>Ventilation Requirements</i>
407.2	Outdoor Air Intakes and			<i>for General Acute Care</i>
	Exhaust Outlets	69		<i>Hospitals, Skilled Nursing</i>
407.3	Air Balance	69		<i>Facilities, Intermediate Care</i>
407.4	Air Circulation	69		<i>Facilities, Correctional Treatment</i>
407.5	Variable Air Volume	70		<i>Centers, Outpatient Facilities,</i>
407.6	Economizers	70		<i>And Licensed Clinics</i>74
408.0	Filters	70	Table 4-B	<i>Filter Efficiencies for Central</i>
408.1	<i>General</i>	70		<i>Ventilation and Air-Conditioning</i>
408.2	<i>Filters for Hospitals</i>	70		<i>Systems In General Acute Care</i>
408.3	<i>Filters for Skilled Nursing</i>			<i>Hospitals, Acute Psychiatric</i>
	<i>Facilities, Intermediate Care</i>			<i>Hospitals, Outpatient Facilities,</i>
	<i>Facilities, and Correctional</i>			<i>and Licensed Clinics</i>79
	<i>Treatment Centers</i>	70		

Table 4-C	<i>Filter Efficiencies for Central Ventilation and Air-Conditioning Systems In Skilled Nursing Facilities and Intermediate Care Facilities And Correctional Treatment Centers</i>	79	506.1	Materials	. . . . .	91
Table 402.1	Minimum Ventilation Rates in Breathing Zone	. . . . .80	506.2	Construction	. . . . .	91
Table 403.2.2	Zone Air Distribution Effectiveness	82	506.3	Penetrations	. . . . .	91
Table 403.7	Minimum Exhaust Rates	. . . . .83	Table 506.2(1)	Minimum Sheet Metal Thickness for Round Ducts	. . . . .	92
CHAPTER 5	EXHAUST SYSTEMS	. . . . .85	506.4	Condensate	. . . . .	93
501.0	General	. . . . .87	506.5	Fittings	. . . . .	93
501.1	Applicability	. . . . .87	506.6	Explosion Venting	. . . . .	93
502.0	Termination	. . . . .87	506.7	Supports	. . . . .	94
502.1	Exhaust Opening Protection	. . . . .87	506.8	Fire Protection	. . . . .	94
502.2	Termination of Exhaust Ducts	. . . . .87	Table 506.2(2)	Minimum Sheet Metal Thickness for Rectangular Ducts	. . . . .	94
Part I	Environmental Air Ducts and Product-Conveying Systems	. . . . .87	506.9	Protection from Physical Damage	. . . . .	95
503.0	Motors, Fans, and Filters	. . . . .87	506.10	Duct Clearances	. . . . .	95
503.1	General	. . . . .87	Table 506.10.4	Basic Minimum Clearances to Unprotected Surfaces	. . . . .	95
503.2	Fans	. . . . .87	506.11	Clearance Reduction Methods	. . . . .	95
504.0	Environmental Air Ducts	. . . . .87	Table 506.11	Reduction of Duct Clearance with Specified forms of Protection	. . . . .	96
504.1	General	. . . . .87	Part II	Commercial Hoods and Kitchen Ventilation	. . . . .	96
504.2	Independent Exhaust Systems	. . . . .88	507.0	General Requirements	. . . . .	96
504.3	Domestic Range	. . . . .88	507.1	Type I Hood Exhaust System	. . . . .	96
504.4	Clothes Dryers	. . . . .88	507.2	Exhaust System	. . . . .	96
504.5	Heat (Energy) Recovery Ventilators	. . . . .89	507.3	Listed Devices	. . . . .	97
504.6	Gypsum Wallboard Ducts	. . . . .89	507.4	Clearance	. . . . .	97
505.0	Product-Conveying Systems	. . . . .89	507.5	Drawings	. . . . .	98
505.1	General	. . . . .89	507.6	Notification of Change	. . . . .	98
505.2	Incompatible Materials	. . . . .89	507.7	<i>Pharmaceutical Compounding Exhaust Discharge</i>	. . . . .	98
505.3	Flammability Limit	. . . . .89	508.0	Type I Hoods	. . . . .	98
505.4	Air-Moving Devices	. . . . .89	508.1	Where Required	. . . . .	98
505.5	Generating Flames, Sparks, or Hot Materials	. . . . .89	508.2	Listed Type I Hood Assemblies	. . . . .	98
505.6	Fire Dampers	. . . . .89	508.3	Construction of Type I Hoods	. . . . .	99
505.7	Fire Detection and Alarm Systems	. . . . .90	508.4	Supports	. . . . .	100
505.8	Product-Conveying Ducts Classification	. . . . .90	508.5	Hood Size	. . . . .	100
505.9	Minimum Velocities and Circulation	. . . . .90	Table 508.5.1.2	Extra-Heavy-Duty Cooking Appliance Airflow	. . . . .	100
Table 505.9	Range of Minimum Duct Design Velocities	. . . . .90	Table 508.5.1.3	Heavy-Duty Cooking Appliance Airflow	. . . . .	100
505.10	Makeup Air	. . . . .90	Table 508.5.1.4	Medium-Duty Cooking Appliance Airflow	. . . . .	100
505.11	Hoods and Enclosures	. . . . .90	Table 508.5.1.5	Light-Duty Cooking Appliance Airflow	. . . . .	101
505.12	<i>Pharmacies – Compounding Area of Parenteral Solutions</i>	. . . . .91	508.6	Solid-Fuel Hood Assemblies	. . . . .	101
506.0	Product-Conveying Ducts	. . . . .91	508.7	Exhaust Outlets	. . . . .	101
			509.0	Grease Removal Devices in Hoods	. . . . .	101
			509.1	Grease Removal Devices	. . . . .	101

TABLE OF CONTENTS

509.2	Installation	101	514.2	Inspection, Testing and	
509.3	Solid-Fuel Grease Removal			Maintenance	113
	Devices	102	514.3	Inspection for Grease Buildup . . .	114
510.0	Exhaust Duct Systems	102	Table 514.3	Schedule of Inspection for	
510.1	General	102		Grease Buildup	114
510.2	Clearance	102	514.4	Cleaning of Exhaust Systems . . .	114
510.3	Openings	102	514.5	Cooking Equipment Maintenance	115
510.4	Listed Grease Ducts	103	515.0	Minimum Safety Requirements	
510.5	Other Grease Ducts	103		for Cooking Equipment	115
510.6	Exterior Installations	105	515.1	Cooking Equipment	115
510.7	Interior Installations	105	515.2	Operating Controls	115
510.8	Underground Installations	106	516.0	Recirculating Systems	115
510.9	Termination of Type I Hood		516.1	General Requirements	115
	Exhaust System	106	516.2	Design Restrictions	115
510.10	Solid-Fuel Duct Systems	107	516.3	Interlocks	116
511.0	Air Movement	107	516.4	Location and Application	
511.1	Exhaust Fans for Commercial			Restrictions	116
	Cooking Operations	107	516.5	Additional Fire Safety	
511.2	Airflow	109		Requirements	116
511.3	Makeup Air	109	516.6	Use and Maintenance	116
511.4	Common Duct (Manifold)		517.0	Solid-Fuel Cooking Operations . .	117
	Systems	109	517.1	Venting Application	117
511.5	Solid-Fuel Air Movement		517.2	Location of Appliances	117
	Requirements	110	517.3	Hoods for Solid-Fuel Cooking . .	117
512.0	Auxiliary Equipment	110	517.4	Exhaust Systems for	
512.1	Dampers	110		Solid-Fuel Cooking	118
512.2	Electrical Equipment	110	517.5	Grease Removal Devices	
512.3	Other Equipment	110		for Solid-Fuel Cooking	118
512.4	Solid-Fuel Auxiliary Equipment . .	110	517.6	Air Movement for Solid-Fuel	
513.0	Fire-Extinguishing Equipment . . .	111		Cooking	118
513.1	General	111	517.7	Fire-Extinguishing Equipment	
513.2	Types of Equipment	111		for Solid-Fuel Cooking	118
513.3	Simultaneous Operation	112	517.8	Other Safety Requirements	119
513.4	Fuel and Electric Power Shutoff . .	112	518.0	Downdraft Appliances	119
513.5	Manual Activation	112	518.1	General	119
513.6	System Annunciation	113	518.2	Ventilation System	119
513.7	Special Design and Application . .	113	518.3	Fire-Extinguishing Equipment . . .	119
513.8	Review and Certification	113	518.4	Airflow Switch or Transducer . . .	119
513.9	Installation Requirements	113	518.5	Surface Materials	120
513.10	Portable Fire Extinguishers	113	519.0	Type II Hood Exhaust System	
513.11	Maintenance	113		Requirements	120
513.12	Solid-Fuel Fire-Extinguishing		519.1	Where Required	120
	Equipment	113	519.2	Construction of Type II Hoods . .	120
514.0	Procedures for the Use,		519.3	Dishwashing Appliances	120
	Inspection, Testing, and		519.4	Type II Exhaust Duct Systems . .	120
	Maintenance of Equipment	113	519.5	Termination of Type II Hood	
514.1	Operating Procedures	113	519.6	Exhaust System	120
				Makeup Air	120

CHAPTER 6	DUCT SYSTEMS121	607.2	Requirements128
601.0	General123	608.0	Use of Under-Floor Space as
601.1	Applicability123		Supply Plenum for Dwelling Units 128
601.2	Sizing Requirements123	608.1	General128
602.0	Material123	608.2	Dwelling Units128
602.1	General123	608.3	Enclosed128
602.2	Combustibles Within Ducts or	608.4	Flammable Materials128
	Plenums123	608.5	Access128
602.3	Metallic123	608.6	Automatic Control128
602.4	Nonmetallic Ducts123	608.7	Temperature Limit128
602.5	Vibration Isolators124	608.8	Noncombustible Receptacle128
602.6	Corridors124	608.9	Floor Registers128
603.0	Installation of Ducts124	608.10	Exterior Wall and Interior Stud
603.1	General124		Partitions128
603.2	Under Floor or Crawl Space124	608.11	Wall Register129
603.3	Metal Ducts124	608.12	Distance from Combustible129
603.4	Flexible Air Ducts124	608.13	Vapor Barrier129
603.5	Plastic Ducts125	608.14	Prohibited129
603.6	Protection of Ducts125	609.0	Automatic Shutoffs129
603.7	Support of Ducts125	609.1	Air-Moving Systems and Smoke
603.8	Protection Against Flood Damage .125		Detectors129
603.9	Joints and Seams of Ducts125	609.2	<i>Air-Moving Systems and Smoke</i>
Table 603.9.1	Closure Markings125		<i>Detectors in Group I-2</i>
603.10	Cross Contamination126		<i>Occupancies129</i>
603.11	Underground Installation126	CHAPTER 7	COMBUSTION AIR131
603.12	Air Dispersion Systems126	701.0	General133
603.13	Clearances126	701.1	Applicability133
604.0	Furnace Plenums and Ducts	701.2	Pressure Difference133
	Used in Fuel-Gas Appliances . . .126	701.3	Makeup Air133
604.1	Furnace Plenums and Air Ducts .126	701.4	Indoor Combustion Air133
604.2	Supplied as a Part of Furnace . .126	701.5	Indoor Opening Size and
604.3	Not Supplied with the Furnace . .126		Location133
604.4	Return Air127	701.6	Outdoor Combustion Air133
605.0	Insulation of Ducts127	701.7	Combination Indoor and Outdoor
605.1	General127		Combustion Air134
606.0	Smoke Dampers, Fire Dampers,	701.8	Engineered Installations135
	and Ceiling Dampers127	701.9	Mechanical Combustion Air
606.1	Smoke Dampers127		Supply135
606.2	Fire Dampers127	701.10	Louvers, Grilles, and Screens . .135
606.3	Ceiling Radiation Dampers127	701.11	Combustion Air Ducts136
606.4	Multiple Arrangements127	701.12	Dampers Prohibited136
606.5	Access and Identification127	702.0	Extra Device or Attachment136
606.6	Freedom from Interference128	702.1	General136
606.7	Temperature Classification	CHAPTER 8	CHIMNEYS AND VENTS137
	of Operating Elements128	801.0	General139
607.0	Ventilating Ceilings128	801.1	Applicability139
607.1	General128		

TABLE OF CONTENTS

801.2 Venting of Gas Appliances139

801.3 Appliances Fueled by Other Fuels . .139

802.0 Venting of Appliances139

802.1 Listing139

802.2 Connection to Venting Systems . .139

802.3 Minimum Safe Performance139

802.4 Type of Venting System to be Used140

802.5 Masonry, Metal, and Factory-Built Chimneys140

Table 802.4 Type of Venting System to be Used141

802.6 Gas Vents143

Table 802.6.1 Roof Pitch Height144

802.7 Single-Wall Metal Pipe145

Table 802.7.3.3 Clearance for Connectors146

802.8 Through-the-Wall Vent Termination147

Table 802.8.2 Through-the-Wall Direct Vent Termination Clearances147

802.9 Condensation Drain147

802.10 Vent Connectors for Category I Appliances147

Table 802.10.1.3 Minimum Thickness for Galvanized Steel Vent Connectors for Low-Heat Appliances148

Table 802.10.1.4 Minimum Thickness for Steel Vent Connectors for Medium-Heat Appliances149

802.11 Vent Connectors for Category II, Category III, and Category IV Appliances150

802.12 Draft Hoods and Draft Controls . .150

802.13 Manually Operated Dampers . . .151

802.14 Obstructions151

802.15 Automatically Operated Vent Dampers151

803.0 Sizing of Category I Venting Systems151

803.1 Single Appliance Vent
Table 803.1.2(1) through
Table 803.1.2(6)151

803.2 Multiple Appliance Vent
Table 803.2(1) through
Table 803.2(9)153

Table 803.2.1 Vent Connector Maximum Length153

Table 803.1.2(1) Type B Double-Wall Gas Vent . .157

Table 803.1.2(2) Type B Double-Wall Gas Vent . .160

Table 803.1.2(3) Masonry Chimney162

Table 803.1.2(4) Masonry Chimney164

Table 803.1.2(5) Single-Wall Metal Pipe or Type B Asbestos-Cement Vent166

Table 803.1.2(6) Exterior Masonry Chimney167

Table 803.2(1) Type B Double-Wall Vent168

Table 803.2(2) Type B Double-Wall Vent172

Table 803.2(3) Masonry Chimney174

Table 803.2(4) Masonry Chimney176

Table 803.2(5) Single-Wall Metal Pipe or Type B Asbestos-Cement Vent . .178

Table 803.2(6) Exterior Masonry Chimney178

Table 803.2(7) Exterior Masonry Chimney179

Table 803.2(8) Exterior Masonry Chimney180

Table 803.2(9) Exterior Masonry Chimney181

CHAPTER 9

INSTALLATION OF

SPECIFIC APPLIANCES183

901.0 General185

901.1 Applicability185

902.0 General185

902.1 Nonindustrial Appliance185

902.2 Combustion Air from Bedroom or Bathroom185

902.3 Added or Converted Appliances . .185

902.4 Type of Gas(es)185

902.5 Safety Shutoff Devices for Unlisted LP-Gas Appliances Used Indoors185

902.6 Fuel Input Rate185

902.7 Use of Air or Oxygen Under Pressure185

902.8 Building Structural Members . . .185

902.9 Flammable Vapors185

902.10 Solid-Fuel Burning Appliances . .185

902.11 Combination of Appliances and Equipment185

902.12 Protection of Gas Appliances from Fumes or Gases other than Products of Combustion . . .185

902.13 Process Air186

902.14 Gas Appliance Pressure Regulators186

902.15 Venting of Gas Appliance Pressure Regulators186

902.16 Bleed Lines for Diaphragm-Type Valves186

903.0 Air-Conditioning Appliances186

TABLE OF CONTENTS

903.1	Electric Air Conditioners	186	906.11	Upper Floor Installations	191
903.2	Gas-Fired Air Conditioners and Heat Pumps	186	906.12	First Floor Installation	191
904.0	Central Heating Boilers and Furnaces	187	906.13	Oil-Fired Floor Furnaces	191
904.1	Location	187	907.0	Wall Furnaces	191
904.2	Clearance	187	907.1	Installation	191
904.3	Assembly and Installation	187	907.2	Location	191
904.4	Temperature or Pressure Limiting Devices	188	907.3	Combustion and Circulating Air . .	191
904.5	Low-Water Cutoff	188	907.4	Oil-Fired Wall Furnaces	191
904.6	Steam Safety and Pressure Relief Valves	188	908.0	Clothes Dryers	191
904.7	Refrigeration Coils	188	908.1	Electric Clothes Dryers	191
Table 904.2.2	Clearances to Combustible Material for Unlisted Furnaces and Boilers	188	908.2	Gas-Fired Clothes Dryers	192
904.8	Cooling Units Used with Heating Boilers	189	909.0	Conversion Burners	192
904.9	Furnace (Upright and Horizontal) .	189	909.1	General	192
904.10	Solid-Fuel-Fired Furnaces	189	910.0	Burner Assemblies	192
904.11	Oil-Fired Central Furnaces	189	910.1	Oil Burners	192
904.12	Commercial or Industrial Gas Heaters	189	910.2	Gas Burners	192
904.13	Electric Central Furnaces	189	911.0	Decorative Appliances for Installation in Vented Fireplaces .	192
905.0	Duct Furnaces	189	911.1	Prohibited Installations	192
905.1	Clearances	189	911.2	Installation	192
905.2	Installation of Duct Furnaces . . .	189	911.3	Fireplace Screens	192
905.3	Access Panels	189	912.0	Gas Fireplaces, Vented	192
905.4	Location of Draft Hoods and Controls	189	912.1	<i>Reserved</i>	192
905.5	Circulating Air	189	912.2	Installation	192
905.6	Duct Furnaces Used with Refrigeration Systems	189	912.3	Combustion and Circulating Air . .	192
905.7	Installation in Commercial Garages and Aircraft Hangars . . .	190	913.0	Factory-Built Fireplaces and Fireplace Stoves	193
905.8	Electric Duct Heaters	190	913.1	Factory-Built Fireplaces	193
906.0	Floor Furnaces	190	913.2	Fireplace Stoves	193
906.1	Installation	190	913.3	Fireplace Accessories	193
906.2	Temperature Limit Controls	190	914.0	Non-Recirculating Direct Gas-Fired Industrial Air Heaters	193
906.3	Combustion and Circulating Air . .	190	914.1	Application	193
906.4	Placement	190	914.2	Prohibited Installations	193
906.5	Bracing	190	914.3	Installation	193
906.6	Support	190	914.4	Clearance from Combustible Materials	193
906.7	Clearance	190	914.5	Air Supply	193
906.8	Access	190	914.6	Atmospheric Vents, Gas Reliefs, or Bleeds	193
906.9	Seepage Pan	190	914.7	Relief Openings	193
906.10	Wind Protection	191	Table 911.2	Free Opening Area of Chimney Damper for Venting Flue Gases from Unlisted Decorative Appliances for Installation in Vented Fireplaces	193
			914.8	Purging	194
			915.0	Recirculating Direct Gas-Fired Industrial Air Heaters	194

TABLE OF CONTENTS

915.1	Application	194	920.4	Built-In Units	197
915.2	Prohibited Installations	194	921.0	Cooking Appliances Listing	197
915.3	Installation	194	921.1	Commercial Electric Ranges	197
915.4	Clearance from Combustible Materials	194	921.2	Commercial Wood-Fired Baking Ovens	198
915.5	Air Supply	194	921.3	Oil-Burning Ranges	198
915.6	Atmospheric Vents, Gas Reliefs, or Bleeds	194	922.0	Open-Top Broiler Units	198
915.7	Relief Openings	194	922.1	Listed Units	198
915.8	Purging	194	922.2	Unlisted Units	198
916.0	Room Heaters	194	922.3	Protection Above Domestic Units .	198
916.1	Electric Room Heaters	194	922.4	Commercial Units	198
916.2	Gas-Fired Room Heaters	194	923.0	Outdoor Cooking Appliances	198
916.3	Solid-Fuel-Type Room Heaters . .	195	923.1	Listed Units	198
917.0	Unit Heaters	195	923.2	Unlisted Units	198
917.1	Support	195	924.0	Illuminating Appliances	198
917.2	Clearance	195	924.1	Clearances for Listed Appliances .	198
917.3	Combustion and Circulating Air . .	195	924.2	Clearances for Unlisted Appliances	198
917.4	Ductwork	195	Table 924.2.1	Clearances for Unlisted Outdoor Open-Flame Illuminating Appliances	198
917.5	Installation in Commercial Garages and Aircraft Hangars . . .	195	924.3	Mounting on Buildings	198
917.6	Oil-Fired Unit Heaters	195	924.4	Mounting on Posts	198
918.0	Food Service Appliance, Floor- Mounted	195	924.5	Appliance Pressure Regulators . .	199
918.1	Clearance for Listed Appliances . .	195	925.0	Incinerators and Crematories	199
918.2	Clearance for Unlisted Appliances	195	925.1	Field Constructed Commercial- Industrial Incinerators	199
918.3	Mounting on Combustible Floors	196	925.2	Factory-Built Commercial Crematories	199
918.4	Installation on Noncombustible Floors	196	925.3	Residential Incinerators	199
918.5	Combustible Material Adjacent to Cooking Top	196	926.0	Infrared Heaters	199
918.6	Use with Casters	196	926.1	Support	199
918.7	Level Installation	196	926.2	Clearance	199
918.8	Ventilation	196	926.3	Combustion and Ventilation Air . .	199
919.0	Food Service Appliances, Counter Appliances	196	926.4	Installation in Commercial Garages and Aircraft Hangars . . .	199
919.1	Vertical Clearance	196	927.0	Pool Heaters	199
919.2	Clearance for Listed Appliances . .	196	927.1	Location	199
919.3	Clearance for Unlisted Appliances	196	927.2	Clearance	199
919.4	Mounting of Unlisted Appliances .	197	927.3	Temperature or Pressure- Limiting Devices	199
920.0	Household Cooking Appliances . . .	197	927.4	Bypass Valves	199
920.1	Electric Household Cooking Appliances	197	927.5	Venting	199
920.2	Gas-Fired Household Cooking Appliances	197	928.0	Refrigerators	199
920.3	Floor-Mounted Units	197	928.1	Clearance	199
			928.2	Venting or Ventilating Kits Approved for Use With a Refrigerator	199

929.0	Gas-Fired Toilets	200	1001.2	Boiler Rooms and Enclosures . . .	205
929.1	Clearance	200	1001.3	Air for Combustion	
929.2	Installation on Combustible			and Ventilation	205
	Floors	200	1001.4	Drainage	205
929.3	Vents	200	1001.5	Mounting	205
930.0	Appliances for Installation		1001.6	Chimneys or Vents	205
	in Manufactured Housing	200	1002.0	Standards	205
930.1	General	200	1002.1	General	205
931.0	Small Ceramic Kilns	200	1002.2	Oil-Burning Boilers	205
931.1	General	200	1002.3	Electric Boilers	205
931.2	Installation	200	1002.4	Solid-Fuel-Fired Boilers	205
931.3	Fuel-Gas Controls	200	1002.5	Dual Purpose Water Heater	205
931.4	Electrical Equipment	200	1003.0	Detailed Requirements	205
931.5	Installations Inside Buildings . . .	200	1003.1	Safety Requirements	205
931.6	Exterior Installations	200	1003.2	Controls	206
932.0	Outdoor Open Flame		1003.3	Gauges	206
	Decorative Appliances	200	1003.4	Stack Dampers	206
932.1	General	200	1003.5	Welding	206
933.0	Evaporative Cooling Systems . . .	201	1004.0	Expansion Tanks	206
933.1	General	201	1004.1	General	206
933.2	Location	201	1004.2	Open-Type Expansion Tanks . . .	206
933.3	Access, Inspection, and Repair . .	201	1004.3	Closed-Type Systems	206
933.4	Installation	201	1004.4	Minimum Capacity of Closed-	
934.0	Refrigeration Appliances	201		Type Tank	206
934.1	Self-Contained Refrigerators		Table 1004.4(1)	Expansion Tank Capacities for	
	and Freezers	201		Gravity Hot Water Systems	206
934.2	Unit Coolers	201	Table 1004.4(2)	Expansion Tank Capacities for	
934.3	Self-Contained Mechanical			Forced Hot Water Systems	207
	Refrigeration Systems	201	1005.0	Safety or Relief Valve Discharge . .	207
935.0	Ductless Mini-Split Systems		1005.1	General	207
	Installation	201	1005.2	Discharge Piping	207
935.1	General	201	1005.3	Splash Shield	207
936.0	Air Filter Appliances	201	1005.4	Hazardous Discharge	207
936.1	Electrostatic Air Cleaners	201	1005.5	Vacuum Relief Valve	207
936.2	High-Efficiency Particulate		1006.0	Shutoff Valves	207
	Air Filter Units	201	1006.1	General	207
937.0	Gaseous Hydrogen Systems . . .	201	1007.0	Gas-Pressure Regulators	207
937.1	General	201	1007.1	General	207
938.0	Compressed Natural Gas (CNG)		1008.0	Low-Water Cutoff	207
	Vehicular Fuel Systems	201	1008.1	General	207
938.1	General	201	1009.0	Combustion Regulators -	
				Safety Valves	207
			1009.1	General	207
			1010.0	Clearance for Access	208
CHAPTER 10	BOILERS AND		1010.1	General	208
	PRESSURE VESSELS	203	1010.2	Power Boilers	208
1001.0	General	205	1010.3	Steam-Heating Boilers, Hot	
1001.1	Applicability	205		Water Boilers, and Power Boilers .	208

TABLE OF CONTENTS

1010.4	Package Boilers, Steam-Heating Boilers, and Hot-Water-Heating Boilers	208	1104.5	Flammable Refrigerants	216
			1104.6	<i>Group A2L Refrigerants for Human Comfort</i>	217
1011.0	Boilers, Stokers, and Steam Generators	208	1104.7	Applications for Human Comfort and for Nonindustrial Occupancies	217
1011.1	General	208	1104.8	Refrigerant Type and Purity	217
1012.0	Operating Adjustments and Instructions	208	1104.9	Changing Refrigerants	218
1012.1	General	208	1105.0	General Requirements	218
1013.0	Inspections and Tests	208	1105.1	Human Comfort	218
1013.1	General	208	1105.2	Supports and Anchorage	218
1013.2	Operating Permit	208	1105.3	Access	218
1013.3	Maintenance Inspection	208	1105.4	Illumination and Service Receptacles	219
1013.4	Power and Miniature Boilers	208	1105.5	Ventilation of Rooms Containing Condensing Units	219
1013.5	Steam-Heating and Water-Heating Boilers	209	1105.6	Prohibited Locations	219
1013.6	Automatic Steam-Heating Boilers	209	1105.7	Condensate	219
1013.7	Unfired Pressure Vessels	209	1105.8	Defrost	219
1014.0	Operation and Maintenance of Boilers and Pressure Vessels	209	1105.9	Overflows	219
1014.1	General	209	1105.10	Condensate, Defrost, and Overflow Disposal	219
Table 1003.2.1	Controls and Limit Devices for Automatic Boilers	210	1105.11	Refrigerant Port Protection	219
			1105.12	Storage	219
			1106.0	Refrigeration Machinery Rooms	219
			1106.1	Where Required	219
CHAPTER 11	REFRIGERATION	213	1106.2	Refrigeration Machinery Room, General Requirements	220
1101.0	General	215	1106.3	Normal Operation	221
1101.1	Applicability	215	1106.4	Natural Ventilation	221
1101.2	Equipment	215	1106.5	Combustion Air	221
Part I	Refrigeration Systems	215	1106.6	Ventilation Intake	221
1102.0	Refrigeration Systems	215	1106.7	Maximum Temperature	221
1102.1	General	215	1106.8	Refrigerant Parts in Air Duct	221
1102.2	Ammonia Refrigeration Systems	215	1106.9	Dimensions	221
1102.3	Refrigerants	215	1106.10	Exits	221
1103.0	Classification	215	1106.11	<i>Machinery Room, A2L and B2L</i>	221
1103.1	Classification of Refrigerants	215	Table 1106.11.10.2	<i>Refrigerant detector set points, response times, alarms, and ventilation levels</i>	223
Table 1103.1.1	<i>Refrigerant Safety Group Classifications</i>	215	Table 1106.11.11.2	<i>Level 1 Ventilation Rate for Class 2L Refrigerants</i>	223
1103.2	Classification of Refrigeration Systems	215	1107.0	Machinery Room, Special Requirements	224
1103.3	Higher Flammability Refrigerants	215	1107.1	General	224
1104.0	Requirements for Refrigerant and Refrigeration System Use	215	1108.0	Refrigeration Machinery Room Equipment and Controls	224
1104.1	System Selection	215	1108.1	General	224
1104.2	Refrigerant Concentration Limit	215	1108.2	Electrical	224
1104.3	Institutional Occupancies	216	1108.3	Emergency Shut-off	224
1104.4	Industrial Occupancies and Refrigerated Rooms	216			

1108.4	Installation, Maintenance, and Testing	224	1112.14	Rating of Rupture Members and Fusible Plugs	232
1108.5	Emergency Pressure Control System	224	1113.0	Overpressure Protection	232
1109.0	Refrigeration Piping, Containers, and Valves	224	1113.1	General	232
1109.1	Materials	224	1113.2	Type of Protection	232
1109.2	Joints	227	1113.3	Discharging into Lowside of System	232
1109.3	Penetration of Piping	227	1113.4	Parallel Pressure-Relief Devices	232
1109.4	Location of Refrigeration Piping	227	1113.5	Discharge Capacity	232
1109.5	Underground Piping	227	Table 1113.5	Relief Devices Capacity Factor	233
1109.6	Support	227	1113.6	Three-Way Valve	233
1109.7	Pipe Enclosure	227	1114.0	Special Discharge Requirements	233
1109.8	Visual Inspection	227	1114.1	General	233
1109.9	Condensation	227	1114.2	Design Requirements	233
1109.10	Identification	228	1114.3	Testing	233
1110.0	Valves	228	1115.0	Labeling and Identification	233
1110.1	More than 6.6 Pounds of Refrigerant	228	1115.1	General	233
1110.2	More than 110 Pounds of Refrigerant	228	1115.2	Volume and Type	233
1110.3	Support	228	1115.3	Permanent Sign	233
1110.4	Access	228	1115.4	Marking of Pressure-Relief Devices	233
1110.5	Identification	228	1115.5	<i>Nameplate</i>	234
1111.0	Pressure-Limiting Devices	228	1116.0	Testing of Refrigeration Equipment	234
1111.1	Where Required	228	1116.1	Factory Tests	234
1111.2	Setting	228	1116.2	Field Tests	234
1111.3	Location	228	Table 1116.2	Field Leak Test Pressures	234
1111.4	Emergency Stop	228	1116.3	Test Gases	234
1112.0	Pressure-Relief Devices	228	1116.4	Declaration	235
1112.1	General	228	1116.5	Brine Systems	235
1112.2	Positive Displacement Compressor	228	1117.0	Refrigerant-Containing Pressure Vessels	235
1112.3	Liquid-Containing Portions of Systems	229	1117.1	Inside Dimensions 6 Inches or Less	235
1112.4	Evaporators	229	1117.2	Inside Dimensions More than 6 Inches	235
1112.5	Hydrostatic Expansion	229	1117.3	Pressure Vessels for 15 psig or Less	235
1112.6	Actuation	229	1118.0	Maintenance and Operation	235
1112.7	Stop Valves Prohibited	229	1118.1	General	235
1112.8	Location	229	Part II	Cooling Towers	235
1112.9	Materials	230	1119.0	General	235
1112.10	Pressure-Relief Device Settings	230	1119.1	Applicability	235
1112.11	Discharge from Pressure-Relief Devices	230	1120.0	Support and Anchorage	235
1112.12	Discharge Piping	231	1120.1	General	235
Table 1112.12.3	Atmospheric Pressure at Nominal Installation Elevation	231	1121.0	Drainage	235
1112.13	Rating of Pressure-Relief Device	232	1121.1	General	235

TABLE OF CONTENTS

1122.0	Chemical Treatment Systems . . .	235	1205.1	Operating Instructions	242
1122.1	General	235	1205.2	Pressure Testing	242
1122.2	Automated Control of Cycles of Concentration	235	1205.3	Flushing	242
1123.0	Location	235	1206.0	Pressure and Safety Devices . . .	242
1123.1	General	235	1206.1	General	242
1124.0	Electrical	236	1206.2	Discharge Piping	242
1124.1	General	236	1207.0	Heating Appliances and Equipment	242
1125.0	Refrigerants and Hazardous Fluids	236	1207.1	General	242
1125.1	General	236	1207.2	Boilers	242
1126.0	Drift Eliminators	236	1207.3	Dual-Purpose Water Heaters . . .	242
1126.1	General	236	1207.4	Solar Heat Collector Systems . .	243
Table 1102.3	Refrigerant Groups, Properties, and Allowable Quantities	237	1208.0	Circulators and Pumps	243
Table 1104.1	Permissible Refrigeration Systems	238.4	1208.1	General	243
CHAPTER 12	HYDRONICS	239	1208.2	Mounting	243
1201.0	General	241	1208.3	Sizing	243
1201.1	Applicability	241	1209.0	Expansion Tanks	243
1201.2	Insulation	241	1209.1	General	243
1201.3	Water Hammer	241	1209.2	Installation	243
1201.4	Terminal Units	241	1209.3	Open-Type Expansion Tanks . . .	243
1201.5	Return-Water Low-Temperature Protection	241	1209.4	Closed-Type Tanks	243
1202.0	Protection of Potable Water Supply	241	1209.5	Sizing	243
1202.1	Prohibited Sources	241	1210.0	Materials	243
1202.2	Chemical Injection	241	1210.1	Piping, Tubing, and Fittings	243
1202.3	Compatibility	241	1210.2	Expansion and Contraction	243
1203.0	Capacity of Heat Source	241	1210.3	Hangers and Supports	243
1203.1	Heat Source	241	1210.4	Oxygen Diffusion Corrosion	243
1203.2	Dual Purpose Water Heater	241	1211.0	Joints and Connections	243
Table 1203.2	Water Heaters	241	1211.1	General	243
1203.3	Tankless Water Heaters	241	Table 1210.1	Materials for Hydronic System Piping, Tubing, and Fittings	244
1204.0	Identification of a Potable and Nonpotable Water System	241	1211.2	Chlorinated Polyvinyl Chloride (CPVC) Pipe	244
1204.1	General	241	1211.3	CPVC/AL/CPVC Plastic Pipe and Joints	245
1204.2	Color and Information	241	1211.4	Copper or Copper Alloy Pipe and Tubing	245
1204.3	Potable Water	241	1211.5	Crossed-Linked Polyethylene (PEX) Pipe	246
1204.4	Nonpotable Water	241	1211.6	Cross-Linked Polyethylene/ Aluminum/Cross-Linked Polyethylene (PEX-AL-PEX) Pipe	246
Table 1204.3	Minimum Length of Color Field and Size of Letters	242	1211.7	Ductile Iron Pipe	246
1204.5	Location of Piping Identification . .	242	1211.8	Polyethylene (PE) Plastic Pipe/Tubing	246
1204.6	Flow Directions	242	1211.9	Polyethylene/Aluminum/ Polyethylene (PE-AL-PE)	246
1205.0	Installation, Testing, and Inspection	242	1211.10	Polyethylene of Raised Temperature (PE-RT)	247
			1211.11	Polypropylene (PP) Pipe	247

1211.12	Polyvinyl Chloride (PVC) Pipe . . .	247	1217.4	Tube Placement	249
1211.13	Steel Pipe and Tubing	247	Table 1217.4	Maximum Length of Continuous Tubing from a Supply-and-Return Manifold Arrangement	250
1211.14	Joints Between Various Materials	247			
1212.0	Valves	248			
1212.1	General	248	1217.5	Poured Floor Structural Concrete Slab Systems (Thermal Mass) . . .	250
1212.2	Where Required	248	1217.6	Joist Systems and Subfloors . . .	250
1212.3	Heat Exchanger	248	1217.7	Wall and Ceiling Panels	250
1212.4	Pressure Vessels	248	1217.8	Radiant Heating and Cooling Panels	251
1212.5	Pressure Reducing Valves	248		Heat Exchangers	251
1212.6	Equipment, Components, and Appliances	248	1218.0	General	251
1212.7	Expansion Tank	248	1218.1	Indirect-Fired Domestic Hot-Water Storage Tanks	251
1212.8	Flow Balancing Valves	248	1219.0	General	251
1212.9	Mixing or Temperature Control Valves	248	1219.1	Snow and Ice Melt Systems	251
1212.10	Thermosiphoning	248	1220.0	Use of Chemical Additives and Corrosive Fluids	251
1212.11	Air Removal Device or Air Vents	248	1220.1	Types of Tube Fasteners	251
1213.0	System Controls	248		Spacing of Tube Fasteners	251
1213.1	Water Temperature Controls . . .	248	1220.2	Snow and Ice Melt Controls	252
1213.2	Operating Steam Controls	248	1220.3	Loop Lengths for Snow and Ice Melt Systems	252
1213.3	Occupied Spaces	248	1220.4	Hydronic Makeup Air Units	252
1213.4	Simultaneous Operation	248	Table 1220.4.1	Piping Installation	252
1213.5	Temperature Reading	248		General	252
1214.0	Pressure and Flow Controls	248	1220.5	Embedded Piping Materials and Joints	252
1214.1	Balancing	248	1221.0	Pressure Testing	253
1214.2	Low-Water Control	248	1221.1	System Drainage	253
1214.3	Flow-Sensing Devices	248	1221.2	Condensate Drainage	253
1214.4	Automatic Makeup Fluid	248		Clearance to Combustibles	253
1214.5	Differential Pressure Regulation .	248	1221.3		
1214.6	Air-Removal Device	249	1221.4		
1214.7	Air-Separation Device	249	1221.5		
1214.8	Secondary Loops	249	1221.6		
1215.0	Hydronic Space Heating	249			
1215.1	General	249	CHAPTER 13	FUEL GAS PIPING	255
1215.2	Installation	249	1301.0	Scope of Gas Piping	257
1215.3	Freeze Protection	249	1301.1	Applicability	257
1215.4	Balancing	249	1302.0	Coverage of Piping System	257
1215.5	Heat Transfer Fluid	249	1302.1	General	257
1216.0	Steam Systems	249	1302.2	Piping System Requirements . . .	257
1216.1	Steam Traps	249	1302.3	Applications	257
1216.2	Sloping for Two-Pipe System . . .	249	1303.0	Inspection	257
1216.3	Sloping for One-Pipe System . . .	249	1303.1	Inspection Notification	257
1216.4	Automatic Air Vents	249	1303.2	Excavation	257
1216.5	Condensate Flow	249	1303.3	Type of Inspections	257
1216.6	Steam-Distribution Piping	249	1303.4	Inspection Waived	258
1217.0	Radiant Heating and Cooling . . .	249	1304.0	Certificate of Inspection	258
1217.1	Installation	249	1304.1	Issuance	258
1217.2	Radiant Under-Floor Heating . . .	249	1304.2	Gas Supplier	258
1217.3	Radiant Cooling Systems	249	1304.3	Unlawful	258
			1305.0	Authority to Render Gas Service	258

TABLE OF CONTENTS

1305.1	Authorized Personnel	258	1310.12	Prohibited Devices	269
1305.2	Outlets	258	1310.13	Systems Containing Gas-Air Mixtures Outside the Flammable Range	269
1306.0	Authority to Disconnect	258	1310.14	Systems Containing Flammable Gas-Air Mixtures	269
1306.1	Disconnection	258	1311.0	Electrical Bonding and Grounding	270
1306.2	Notice	258	1311.1	Pipe and Tubing other than CSST	270
1306.3	Capped Outlets	258	1311.2	Bonding of CSST Gas Piping	270
1307.0	Temporary Use of Gas	258	1311.3	Arc-Resistant Jacketed CSST	271
1307.1	General	258	1311.4	Prohibited Use	271
1308.0	Gas Piping System Design, Materials, and Components	258	1311.5	Lightning Protection System	271
1308.1	Installation of Piping System	258	1311.6	Electrical Circuits	271
1308.2	Provision for Location of Point of Delivery	258	1311.7	Electrical Connections	271
1308.3	Interconnections Between Gas Piping Systems	258	1312.0	Appliance and Equipment Connections to Building Piping	271
1308.4	Sizing of Gas Piping Systems	259	1312.1	Connecting Appliances and Equipment	271
1308.5	Acceptable Piping Materials and Joining Methods	259	1312.2	Suspended Low-Intensity Infrared Tube Heaters	271
Table 1308.4.1	Approximate Gas Input for Typical Appliances	259	1312.3	Use of Nonmetallic Gas Hose Connectors	271
Table 1308.5.6.2	Specifications for Threading Metallic Pipe	260	1312.4	Injection (Bunsen) Burners	272
1308.6	Gas Meters	262	1312.5	Connection of Portable and Mobile Industrial Appliances	272
1308.7	Gas Pressure Regulators	263	1312.6	Appliance Shutoff Valves and Connections	272
1308.8	Overpressure Protection	263	1312.7	Quick-Disconnect Devices	272
1308.9	Pressure Limitation Requirements	263	1312.8	Gas Convenience Outlets	272
1308.10	Overpressure Protection Devices	264	1312.9	Sediment Trap	272
1308.11	Backpressure Protection	264	1312.10	Installation of Piping	272
1308.12	Low-Pressure Protection	264	1312.11	Liquefied Petroleum Gas Facilities and Piping	272
1308.13	Shutoff Valves	264	1313.0	Pressure Testing, Inspection, and Purging	272
1308.14	Expansion and Flexibility	264	1313.1	Piping Installations	272
1309.0	Excess Flow Valve	265	1313.2	Test Preparation	273
1309.1	General	265	1313.3	Test Pressure	273
1310.0	Gas Piping Installation	265	1313.4	Detection of Leaks and Defects	273
1310.1	Piping Underground	265	1313.5	Piping System Leak Test	273
1310.2	CSST Piping Systems	266	1313.6	Purging Requirements	274
1310.3	Installation of Aboveground Piping	266	Table 1313.6.1	Size and Length of Piping	274
Table 1310.3.5.1	Support of Piping	267	1314.0	Required Gas Supply	275
1310.4	Concealed Piping in Buildings	267	1314.1	General	275
1310.5	Piping in Vertical Chases	267	1314.2	Volume	275
1310.6	Maximum Operating Pressure in Buildings	268	1314.3	Gas Appliances	275
1310.7	Appliance Overpressure Protection	268	1314.4	Size of Piping Outlets	275
1310.8	Gas Pipe Turns	268	1315.0	Required Gas Piping Size	275
1310.9	Drips and Sediment Traps	268			
1310.10	Outlets	268			
1310.11	Manual Gas Shutoff Valves	269			

1315.1	Pipe Sizing Methods	275	Table 1315.2(34)	Polyethylene Plastic Pipe	310
1315.2	Sizing of Gas Piping Systems . .	275	Table 1315.2(35)	Polyethylene Plastic Pipe	311
1315.3	Sizing Equations	275	Table 1315.2(36)	Polyethylene Plastic Tubing	312
Table 1315.3	Cr and Y for Natural Gas and Undiluted Propane at Standard Conditions	276	CHAPTER 14	PROCESS PIPING	313
1315.4	Sizing of Piping Sections	276	1401.0	General	315
1315.5	Engineering Methods	276	1401.1	Applicability	315
1315.6	Variable Gas Pressures	276	1402.0	Permit	315
Table 1315.2(1)	Schedule 40 Metallic Pipe	278	1402.1	General	315
Table 1315.2(2)	Schedule 40 Metallic Pipe	279	1403.0	Plans Required	315
Table 1315.2(3)	Schedule 40 Metallic Pipe	280	1403.1	General	315
Table 1315.2(4)	Schedule 40 Metallic Pipe	281	1404.0	Workmanship	315
Table 1315.2(5)	Schedule 40 Metallic Pipe	282	1404.1	General	315
Table 1315.2(6)	Schedule 40 Metallic Pipe	283	1405.0	Inspections	315
Table 1315.2(7)	Semi-Rigid Copper Tubing	284	1405.1	General	315
Table 1315.2(8)	Semi-Rigid Copper Tubing	285	1405.2	Required Inspections	315
Table 1315.2(9)	Semi-Rigid Copper Tubing	286	1405.3	Other Inspections	315
Table 1315.2(10)	Semi-Rigid Copper Tubing	287	1406.0	Pipe, Tubing, and Fittings	315
Table 1315.2(11)	Semi-Rigid Copper Tubing	288	1406.1	General	315
Table 1315.2(12)	Semi-Rigid Copper Tubing	289	1406.2	Hazardous Process Piping (HPP)	315
Table 1315.2(13)	Semi-Rigid Copper Tubing	290	1406.3	Special Requirements for HPP Gases	316
Table 1315.2(14)	Corrugated Stainless Steel Tubing (CSST)	291	CHAPTER 15	SOLAR ENERGY SYSTEMS . .	317
Table 1315.2(15)	Corrugated Stainless Steel Tubing (CSST)	292	1501.0	General	319
Table 1315.2(16)	Corrugated Stainless Steel Tubing (CSST)	293	1501.1	Applicability	319
Table 1315.2(17)	Corrugated Stainless Steel Tubing (CSST)	294	1502.0	General	319
Table 1315.2(18)	Corrugated Stainless Steel Tubing (CSST)	295	CHAPTER 16	STATIONARY POWER PLANTS	321
Table 1315.2(19)	Polyethylene Plastic Pipe	296	1601.0	Stationary Fuel Cell Power Plants	323
Table 1315.2(20)	Polyethylene Plastic Pipe	297	1601.1	General	323
Table 1315.2(21)	Polyethylene Plastic Pipe	298	1602.0	Stationary Gas Engines and Generators	323
Table 1315.2(22)	Polyethylene Plastic Tubing	299	1602.1	<i>Gas Engines</i>	323
Table 1315.2(23)	Polyethylene Plastic Tubing	299	1602.2	<i>Liquid-Fueled Engines and Gas Supply Piping</i>	323
Table 1315.2(24)	Schedule 40 Metallic Pipe	300	1602.3	Stationary Engine Generators . .	323
Table 1315.2(25)	Schedule 40 Metallic Pipe	301	CHAPTER 17	REFERENCED STANDARDS . .	325
Table 1315.2(26)	Schedule 40 Metallic Pipe	302	1701.0	General	327
Table 1315.2(27)	Schedule 40 Metallic Pipe	303	1701.1	Standards	327
Table 1315.2(28)	Semi-Rigid Copper Tubing	304	Table 1701.1	Referenced Standards	327
Table 1315.2(29)	Semi-Rigid Copper Tubing	305	1701.2	Standards, Publications, Practices, and Guides	340
Table 1315.2(30)	Semi-Rigid Copper Tubing	306	Table 1701.2	Standards, Publications, Practices, and Guides	340
Table 1315.2(31)	Corrugated Stainless Steel Tubing (CSST)	307			
Table 1315.2(32)	Corrugated Stainless Steel Tubing (CSST)	308			
Table 1315.2(33)	Corrugated Stainless Steel Tubing (CSST)	309			

TABLE OF CONTENTS

APPENDICES	TABLE OF CONTENTS	347
Appendix A	Residential Plans Examiner Review Form for HVAC System Design . . . . .	.349
Appendix B	Procedures to be Followed to Place Gas Equipment in Operation . . . . .	.353
Appendix C	Installation and Testing of Oil (Liquid) Fuel-Fired Equipment . . .	.357
Appendix D	Fuel Supply: Manufactured/Mobile Home Parks and Recreational Vehicle Parks . . . . .	.365
Appendix E	Sustainable Practices . . . . .	.373
Appendix F	Geothermal Energy Systems . . . .	.481
Appendix G	Sizing of Venting Systems and Outdoor Combustion and Ventilation Opening Design . . . .	.493
Appendix H	Example Calculation of Outdoor Air Rate . . . . .	.505
USEFUL TABLES	. . . . .	509
INDEX	. . . . .	517
HISTORY NOTE		
APPENDIX	. . . . .	535

Authority Cited – Education Code Section 81053.

References – Education Code Sections 81052, 81053, and 81130 through 81147.

1.9.2.2.1 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.9.2.2 will be identified in the Matrix Adoption Tables under the acronym DSA-SS/CC.

1.10.0 Office of Statewide Health Planning and Development.

1.10.1 OSHPD 1 and OSHPD 1R. Specific scope of application of the agency responsible for enforcement, enforcement agency, specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 1 and OSHPD 1R

Application – [OSHPD 1] General acute-care hospital buildings. [OSHPD 1R] Non-conforming hospital SPC or freestanding buildings that have been removed from acute care service.

Enforcing Agency – Office of Statewide Health Planning and Development (OSHPD). The office shall enforce the Division of the State Architect access compliance regulations and the regulations of the Office of the State Fire Marshal for the above stated facility types.

1.10.1.1 Applicable Administrative Standards:

- (1) Title 24, Part 1, California Code of Regulations: Chapters 6 and 7.
- (2) Title 24, Part 2, California Code of Regulations: Sections 1.1.0 and 1.10.0, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.

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

Authority Cited – Health and Safety Code Sections 127010, 127015, 1275, and 129850.

References – Health and Safety Code Sections 19958, 127010, 127015, 129680, 1275, and 129675 through 130070.

1.10.1.3 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.10.1 will be identified in the Matrix Adoption Tables under the acronym OSHPD 1, and OSHPD 1R.

1.10.2 OSHPD 2. Specific scope of application of the agency responsible for enforcement, enforcement agency, specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 2

Application – Skilled nursing facilities and intermediate care facility buildings.

Enforcing Agency – Office of Statewide Health Planning and Development (OSHPD). The office shall also enforce the Division of the State Architect access compli-

ance regulations and the regulations of the Office of the State Fire Marshal for the above stated facility type.

1.10.2.1 Applicable Administrative Standards:

- (1) Title 24, Part 1, California Code of Regulations: Chapter 7.
- (2) Title 24, Part 2, California Code of Regulations: Sections 1.1.0 and 1.10.0, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.

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

Authority Cited – Health and Safety Code Sections 127010, 127015, 1275, and 129850.

References – Health and Safety Code Sections 127010, 127015, 1275, and 129680.

1.10.2.3 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.10.2 will be identified in the Matrix Adoption Tables under the acronym OSHPD 2.

1.10.3 OSHPD 3. Specific scope of application of the agency responsible for enforcement, enforcement agency, specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 3

Application – Licensed clinics and any freestanding building under a hospital license where outpatient clinical services are provided.

Enforcing Agency – Local building department.

1.10.3.1 Applicable Administrative Standards.

- (1) Title 24, Part 1, California Code of Regulations: Chapter 7.
- (2) Title 24, Part 2, California Code of Regulations: Sections 1.1.0 and 1.10.0, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.

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

Authority Cited – Health and Safety Code Sections 127010, 127015, and 1226.

References – Health and Safety Code Sections 127010, 127015, 129885, and 1226, Government Code Section 54350, and State Constitution Article II Section 7.

1.10.3.3 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.10.3 will be identified in the Matrix Adoption Tables under the acronym OSHPD 3.

1.10.4 OSHPD 4. Specific scope of application of the agency responsible for enforcement, enforcement agency, specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 4

Application – Correctional Treatment Centers.

Enforcing Agency – Office of Statewide Health Planning and Development (OSHPD). The Office shall also enforce the Division of the State Architect access compliance regulations and the regulations of the Office of the State Fire Marshal for the above stated facility types.

1.10.4.1 Applicable Administrative Standards:

- (1) Title 24, Part 1, California Code of Regulations: Chapter 7.
- (2) Title 24, Part 2, California Code of Regulations: Sections 1.1.0 and 1.10.0, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.

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

Authority Cited – Health and Safety Code Sections 127010, 127015, and 129790.

References – Health and Safety Code Sections 127010, 127015, 1275, and 129675 through 130070.

1.10.4.3 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.10.4 will be identified in the Matrix Adoption Tables under the acronym OSHPD 4.

1.10.5 OSHPD 5. Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

OSHPD 5

Application – Acute psychiatric hospital buildings.

Enforcing Agency – Office of Statewide Health Planning and Development (OSHPD). The office shall also enforce the Division of the State Architect – Access Compliance regulations and the regulations of the Office of the State Fire Marshal for the above-stated facility types.

1.10.5.1 Applicable Administrative Standards.

- (1) Title 24, Part 1, California Code of Regulations: Chapter 7.
- (2) Title 24, Part 2, California Code of Regulations: Sections 1.1.0 and 1.10.0, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.

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

Authority Cited – Health and Safety Code Sections 1275 and 129850.

References – Health and Safety Code Sections 129680, 1275 and 129675 through 130070.

1.10.5.3 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Subsection 1.10.5 will be identified in the Matrix Adoption Tables under the Acronym OSHPD 5.

1.11.0 Office of the State Fire Marshal.

1.11.1 SFM – Office of the State Fire Marshal. Specific scope of application of the agency responsible for enforcement, the enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

Application:

Institutional, Educational, or any Similar Occupancy. Any building or structure used or intended for use as an asylum, jail, prison, mental hospital, hospital, sanitarium, home for the elderly, children’s nursery, children’s home or institution, school, or any similar occupancy of any capacity.

Authority Cited – Health and Safety Code Section 13143.

Reference – Health and Safety Code Section 13143.

Assembly or Similar Place of Assemblage. Any theater, dancehall, skating rink, auditorium, assembly hall, meeting hall, nightclub, fair building or similar place of assemblage where 50 or more persons may gather together in a building, room or structure for the purpose of amusement, entertainment, instruction, deliberation, worship, drinking or dining, awaiting transportation, or education.

Authority Cited – Health and Safety Code Section 13143.

Reference – Health and Safety Code Section 13143.

Small Family Day Care Homes.

Authority Cited – Health and Safety Code Sections 1597.45, 1597.54, 13143, and 17921.

Reference – Health and Safety Code Section 13143.

Large Family Day Care Homes.

Authority Cited – Health and Safety Code Sections 1597.46, 1597.54, and 17921.

Reference – Health and Safety Code Section 13143.

Residential Facilities and Residential Facilities for the Elderly.

Authority Cited – Health and Safety Code Section 13133.

Reference – Health and Safety Code Section 13143.

Any State Institution or Other State-Owned or Specified State-Occupied Building.

Specified State-Occupied Buildings. Any building, structure or area that meets any of the following criteria:

- (1) A building where the state has contracted into a build-to-suit lease.
- (2) A courthouse holding facility or trial court with a detention area.
- (3) A building used by the Department of Corrections and Rehabilitation (CDCR) as a community correctional reentry center.
- (4) 100 percent state occupied.
- (5) State-occupied areas in a state-leased building that is a high-rise and is 75 percent of the net area floor space or more occupied by state entities.

- (6) State-occupied areas in a building that contains 5,000 square feet (465 m²) or more space of state-leased Group H or Group L occupancy.
- (7) A state-leased building with facilities with the primary purpose of housing state records and/or state artifacts of historical significance.
- (8) Properties leased by California State University (CSU).
- (9) State institutions and their real property.
- (10) CAL FIRE occupied areas in leased buildings.
- (11) State-leased facilities where the governing body's fire protection services rely on an all-volunteer fire department.

Authority Cited – Health and Safety Code Sections 13108, 13145, 13146, 16022.5 and 17921.

Reference – Health and Safety Code Sections 13108, 13143, 13145, 13146, 16022.5 and 17921.

High-Rise Structures.

Authority Cited – Health and Safety Code Section 13211.

Reference – Health and Safety Code Section 13143.

Motion Picture Production Studios.

Authority Cited – Health and Safety Code Section 13143.1.

Reference – Health and Safety Code Section 13143.

Organized Camps.

Authority Cited – Health and Safety Code Section 18897.3.

Reference – Health and Safety Code Section 13143.

Residential. All hotels, motels, lodging houses, apartment houses, and dwellings, including congregate residences and buildings and structures accessory thereto. Multiple-story structures existing on January 1, 1975, let for human habitation, including and limited to, hotels, motels and apartment houses, less than 75 feet (22 860 mm) above the lowest floor level having building access, wherein rooms used for sleeping are let above the ground floor.

Authority Cited – Health and Safety Code Sections 13143.2 and 17921.

Reference – Health and Safety Code Section 13143.

Residential Care Facilities. Certified family care homes, out-of-home placement facilities, halfway houses, drug and/or alcohol rehabilitation facilities and any building or structure used or intended for use as a home or institution for the housing of any person of any age when such person is referred to or placed within such home or institution for protective social care and supervision services by any governmental agency.

Authority Cited – Health and Safety Code Section 13143.6.

Reference – Health and Safety Code Section 13143.

Tents, Awnings, or other Fabric Enclosures Used in Connection with any Occupancy.

Authority Cited – Health and Safety Code Section 13116.

Reference – Health and Safety Code Section 13143.

Fire Alarm Devices, Equipment, and Systems in Connection with any Occupancy.

Authority Cited – Health and Safety Code Section 13114.

Reference – Health and Safety Code Section 13143.

Hazardous Materials.

Authority Cited – Health and Safety Code Section 13143.9.

Reference – Health and Safety Code Section 13143.

Flammable and Combustible Liquids.

Authority Cited – Health and Safety Code Section 13143.6.

Reference – Health and Safety Code Section 13143.

Public School Automatic Fire Detection, Alarm, and Sprinkler Systems.

Authority Cited – Health and Safety Code Section 13143 and California Education Code Article 7.5, Sections 17074.50, 17074.52, and 17074.54.

References – Government Code Section 11152.5, Health and Safety Code Section 13143 and California Education Code Chapter 12.5, Leroy F. Greene School Facilities Act of 1998, Article 1.w.

Wildland-Urban Interface Fire Area.

Authority Cited – Health and Safety Code Sections 13143, 13108.5(a), 18949.2(b), (c) and Government Code Section 51189.

References – Health and Safety Code Sections 13143, Government Code Sections 51176, 51177, 51178, and 51179 and Public Resources Code Sections 4201 through 4204.

1.11.2 Duties and Powers of the Enforcing Agency.

1.11.2.1 Enforcement.

1.11.2.1.1 The responsibility for enforcement of building standards adopted by the State Fire Marshal and published in the California Building Standards Code relating to fire and panic safety and other regulations of the State Fire Marshal shall except as provided in Section 1.11.2.1.2 be as follows:

- (1) The city, county, or city and county with jurisdiction in the area affected by the standard or regulation shall delegate the enforcement of the building standards relating to fire and panic safety and other regulations of the State Fire Marshal as they relate to Group R-3 occupancies, as described in Section 310.1 of Part 2 of the California Building Standards Code, to either of the following:
 - 1.1. The chief of the fire authority of the city, county, or city and county, or an authorized representative.
 - 1.2. The chief building official of the city, county, or city and county, or an authorized representative.
- (2) The chief of any city or county fire department or of any fire protection district, and authorized representatives, shall enforce within the jurisdic-

tion the building standards and other regulations of the State Fire Marshal, except those described in Item 1 or 4.

- (3) The State Fire Marshal shall have authority to enforce the building standards and other regulations of the State Fire Marshal in areas outside of corporate cities and districts providing fire protection services.
- (4) The State Fire Marshal shall have authority to enforce the building standards and other regulations of the State Fire Marshal in corporate cities and districts providing fire protection services on request of the chief fire official or the governing body.
- (5) Any fee charged pursuant to the enforcement authority of this section shall not exceed the estimated reasonable cost of providing the service for which the fee is charged pursuant to Section 66014 of the Government Code.

1.11.2.1.2 Pursuant to Health and Safety Code Section 13108, and except as otherwise provided in this section, building standards adopted by the State Fire Marshal published in the California Building Standards Code relating to fire and panic safety shall be enforced by the State Fire Marshal in all state-owned buildings, state-occupied buildings, and state institutions throughout the state. Upon the written request of the chief fire official of any city, county or fire protection district, the State Fire Marshal may authorize such chief fire official and his or her authorized representatives, in their geographical area of responsibility, to make fire prevention inspections of state-owned or state-occupied buildings, other than state institutions, for the purpose of enforcing the regulations relating to fire and panic safety adopted by the State Fire Marshal pursuant to this section and building standards relating to fire and panic safety published in the California Building Standards Code. Authorization from the State Fire Marshal shall be limited to those fire departments or fire districts which maintain a fire prevention bureau staffed by paid personnel.

Pursuant to Health and Safety Code Section 13108, any requirement or order made by any chief fire official who is authorized by the State Fire Marshal to make fire prevention inspections of state-owned or state-occupied buildings, other than state institutions, may be appealed to the State Fire Marshal. The State Fire Marshal shall, upon receiving an appeal and subject to the provisions of Chapter 5 (commencing with Section 18945) of Part 2.5 of Division 13 of the Health and Safety Code, determine if the requirement or order made is reasonably consistent with the fire and panic safety regulations adopted by the State Fire Marshal and building standards relating to fire and panic safety published in the California Building Code.

Any person may request a code interpretation from the State Fire Marshal relative to the intent of

any regulation or provision adopted by the State Fire Marshal. When the request relates to a specific project, occupancy or building, the State Fire Marshal shall review the issue with the appropriate local enforcing agency prior to rendering such code interpretation.

1.11.2.1.3 Pursuant to Health and Safety Code Section 13112, any person who violates any order, rule or regulation of the State Fire Marshal is guilty of a misdemeanor punishable by a fine of not less than \$100.00 or more than \$500.00, or by imprisonment for not less than six months, or by both. A person is guilty of a separate offense each day during which he or she commits, continues or permits a violation of any provision of, or any order, rule or regulation of, the State Fire Marshal as contained in this code.

Any inspection authority who, in the exercise of his or her authority as a deputy State Fire Marshal, causes any legal complaints to be filed or any arrest to be made shall notify the State Fire Marshal immediately following such action.

1.11.2.2 Right of Entry. The fire chief of any city, county, or fire protection district, or such person's authorized representative, may enter any state institution or any other state-owned or state-occupied building for the purpose of preparing a fire suppression preplanning program or for the purpose of investigating any fire in a state-occupied building.

The State Fire Marshal, his or her deputies or salaried assistants, the chief of any city or county fire department or fire protection district and his or her authorized representatives may enter any building or premises not used for dwelling purposes at any reasonable hour for the purpose of enforcing this chapter. The owner, lessee, manager or operator of any such building or premises shall permit the State Fire Marshal, his or her deputies or salaried assistants and the chief of any city or county fire department or fire protection district and his or her authorized representatives to enter and inspect them at the time and for the purpose stated in this section.

1.11.2.3 More Restrictive Fire and Panic Safety Building Standards.

1.11.2.3.1 Any fire protection district organized pursuant to Health and Safety Code Part 2.7 (commencing with Section 13800) of Division 12 may adopt building standards relating to fire and panic safety that are more stringent than those building standards adopted by the State Fire Marshal and contained in the California Building Standards Code. For these purposes, the district board shall be deemed a legislative body and the district shall be deemed a local agency. Any changes or modifications that are more stringent than the requirements published in the California Building Standards Code relating to fire and panic safety shall be subject to Section 1.1.8.1.

1.11.2.3.2 Any fire protection district that proposes to adopt an ordinance pursuant to this section shall, not less than 30 days prior to noticing a proposed ordi-

nance for public hearing, provide a copy of that ordinance, together with the adopted findings made pursuant to Section 1.11.2.3.1, to the city, county, or city and county where the ordinance will apply. The city, county, or city and county may provide the district with written comments, which shall become part of the fire protection district's public hearing record.

1.11.2.3.3 The fire protection district shall transmit the adopted ordinance to the city, county, or city and county where the ordinance will apply. The legislative body of the city, county, or city and county may ratify, modify or deny an adopted ordinance and transmit its determination to the district within 15 days of the determination. Any modification or denial of an adopted ordinance shall include a written statement describing the reasons for any modifications or denial. No ordinance adopted by the district shall be effective until ratification by the city, county, or city and county where the ordinance will apply. Upon ratification of an adopted ordinance, the city, county, or city and county shall file a copy of the findings of the district, and any findings of the city, county, or city and county, together with the adopted ordinance expressly marked and identified to which each finding refers, in accordance with Section 1.1.8.1, Item 3.

1.11.2.4 Request for Alternate Means of Protection.

Requests for approval to use an alternative material, assembly or materials, equipment, method of construction, method of installation of equipment or means of protection shall be made in writing to the enforcing agency by the owner or the owner's authorized representative and shall be accompanied by a full statement of the conditions. Sufficient evidence or proof shall be submitted to substantiate any claim that may be made regarding its conformance. The enforcing agency may require tests and the submission of a test report from an approved testing organization as set forth in Title 19, California Code of Regulation, to substantiate the equivalency of the proposed alternative means of protection.

When a request for alternate means of protection involves hazardous materials, the authority having jurisdiction may consider implementation of the findings and recommendations identified in a Risk Management Plan (RMP) developed in accordance with Title 19, Division 2, Chapter 4.5, Article 3.

Approval of a request for use of an alternative material, assembly of materials, equipment, method of construction, method of installation of equipment, or means of protection made pursuant to these provisions shall be limited to the particular case covered by request and shall not be construed as establishing any precedent for any future request.

1.11.2.5 Appeals. When a request for an alternate means of protection has been denied by the enforcing agency, the applicant may file a written appeal to the State Fire Marshal for consideration of the applicant's proposal. In considering such appeal, the State Fire Marshal may seek the advice of the State Board of Fire Services. The State Fire Marshal shall, after considering all of the facts

presented, including any recommendations of the State Board of Fire Services, determine if the proposal is for the purposes intended, at least equivalent to that specified in these regulations in quality, strength, effectiveness, fire resistance, durability and safety, and shall transmit such findings and any recommendations to the applicant and to the enforcing agency.

1.11.3 Construction Documents.

1.11.3.1 Public Schools. Plans and specifications for the construction, alteration, or addition to any building owned, leased, or rented by any public school district shall be submitted to the Division of the State Architect.

1.11.3.2 Movable Walls and Partitions. Plans or diagrams shall be submitted to the enforcing agency for approval before the installation of, or rearrangement of, any movable wall or partition in any occupancy. Approval shall be granted only if there is no increase in the fire hazard.

1.11.3.3 New Construction High-Rise Buildings:

- (1) Complete plans or specifications, or both, shall be prepared covering all work required to comply with new construction high-rise buildings. Such plans and specifications shall be submitted to the enforcing agency having jurisdiction.
- (2) All plans and specifications shall be prepared under the responsible charge of an architect or a civil or structural engineer authorized by law to develop construction plans and specifications, or by both such architect and engineer. Plans and specifications shall be prepared by an engineer duly qualified in that branch of engineering necessary to perform such services. Administration of the work of construction shall be under the charge of the responsible architect or engineer except that where plans and specifications involve alterations or repairs, such work of construction may be administered by an engineer duly qualified to perform such services and holding a valid certificate under Chapter 7 (commencing with Section 65700) of Division 3 of the Business and Professions Code for performance of services in that branch of engineering in which said plans, specifications and estimates and work of construction are applicable.

This section shall not be construed as preventing the design of fire-extinguishing systems by persons holding a C-16 license issued pursuant to Division 3, Chapter 9, Business and Professions Code. In such instances, however, the responsibility charge of this section shall prevail.

1.11.3.4 Existing High-Rise Buildings:

- (1) Complete plans or specifications, or both, shall be prepared covering all work required by Section 3412 for existing high-rise buildings. Such plans or specifications shall be submitted to the enforcing agency having jurisdiction.
- (2) When new construction is required to conform with the provisions of these regulations, complete plans or specifications, or both, shall be prepared in accordance with the provisions of this subsection. As used in this section, "new construction" is not intended to include repairs, replacements or minor alterations

which do not disrupt or appreciably add to or affect the structural aspects of the building.

1.11.3.5 Retention of Plans. Refer to Building Standards Law, Health and Safety Code Sections 19850 and 19851 for permanent retention of plans.

1.11.4 Fees.

1.11.4.1 Other Fees. Pursuant to Health and Safety Code Section 13146.2, a city, county, or district which inspects a hotel, motel, lodging house, or apartment house may charge and collect a fee for the inspection from the owner of the structure in an amount, as determined by the city, county or district, sufficient to pay its costs of that inspection.

1.11.4.2 Large Family Day Care. Pursuant to Health and Safety Code Section 1597.46, Large Family Day Care Homes, the local government shall process any required permit as economically as possible, and fees charged for review shall not exceed the costs of the review and permit process.

1.11.4.3 High-Rise. Pursuant to Health and Safety Code Section 13217, High-rise Structure Inspection: Fees and costs, a local agency which inspects a high-rise structure pursuant to Health and Safety Code Section 13217 may charge and collect a fee for the inspection from the owner of the high-rise structure in an amount, as determined by the local agency, sufficient to pay its costs of that inspection.

1.11.4.4 Fire Clearance Preinspection. Pursuant to Health and Safety Code Section 13235, Fire Clearance Preinspection fee, upon receipt of a request from a prospective licensee of a community care facility, as defined in Section 1502, of a residential care facility for the elderly, as defined in Section 1569.2, or of a child day care facility, as defined in Section 1596.750, the local fire enforcing agency, as defined in Section 13244, or State Fire Marshal, whichever has primary jurisdiction, shall conduct a preinspection of the facility prior to the final fire clearance approval. At the time of the preinspection, the primary fire enforcing agency shall price consultation and interpretation of the fire safety regulations and shall notify the prospective licensee of the facility in writing of the specific fire safety regulations which shall be enforced in order to obtain fire clearance approval. A fee equal to, but not exceeding, the actual cost of the preinspection services may be charged for the preinspection of a facility.

1.11.4.5 Care Facilities. The primary fire enforcing agency shall complete the final fire clearance inspection for a community care facility, residential care facility for the elderly, or child day care facility within 30 days of receipt of the request for the final inspection, or as of the date the prospective facility requests the final preclearance inspection by the State Department of Social Services, whichever is later.

Pursuant to Health and Safety Code Section 13235, a preinspection fee equal to, but not exceeding, the actual cost of the preinspection services may be charged for the preinspection of a facility.

Pursuant to Health and Safety Code Section 13131.5, a reasonable final inspection fee, not to exceed the actual cost of inspection services necessary to complete a final inspection may be charged for occupancies classified as Residential Care Facilities for the Elderly (RCFE).

Pursuant to Health and Safety Code Section 1569.84, neither the State Fire Marshal nor any local public entity shall charge any fee for enforcing fire inspection regulations pursuant to state law or regulation or local ordinance, with respect to Residential Care Facilities for the Elderly (RCFE) which service six or fewer persons.

1.11.4.6 Requests of the Office of the State Fire Marshal. Whenever a local authority having jurisdiction requests that the State Fire Marshal perform plan review and/or inspection services related to a building permit, the applicable fees for such shall be payable to the Office of the State Fire Marshal.

1.11.5 Inspections. Work performed subject to the provisions of this code shall comply with the inspection requirements of Title 24, Part 2, California Building Standards Code, Sections 109.1, 109.3, 109.3.4, 109.3.5, 109.3.6, 109.3.8, 109.3.9, 109.3.10, 109.5, and 109.6 as adopted by the Office of the State Fire Marshal.

1.11.5.1 Existing Group I-1 or R Occupancies. Licensed 24-hour care in a Group I-1 or R occupancy in existence and originally classified under previously adopted state codes shall be reinspected under the appropriate previous code, provided there is no change in the use or character which would place the facility in a different occupancy group.

1.11.6 Certificate of Occupancy. A Certificate of Occupancy shall be issued as specified in Title 24, Part 2, California Building Code, Section 111.

Exception: Certificates of occupancy are not required for work exempt from permits in accordance with Section 105.2 of the California Building Code.

1.11.7 Temporary Structures and Uses. See Title 24, Part 2, California Building Code, Section 108.

1.11.8 Service Utilities. See Title 24, Part 2, California Building Code, Section 112.

1.11.9 Stop Work Order. See Title 24, Part 2, California Building Code, Section 115.

1.11.10 Unsafe Buildings, Structures, and Equipment. See Title 24, Part 2, California Building Code, Section 116.

1.11.11 Adopting Agency Identification. The provisions of this code applicable to buildings identified in this Section 1.11.0 will be identified in the Matrix Adoption Tables under the acronym SFM.

1.12.0 Reserved for the State Librarian.

1.13.0 Reserved for the Department of Water Resources.

1.14.0 Reserved for the State Lands Commission.

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 2 – DEFINITIONS**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD					BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4									5
Adopt Entire Chapter																						
Adopt Entire Chapter as amended (amended sections listed below)	X		X	X	X		X	X	X	X		X	X	X	X							
Adopt only those sections that are listed below																						
Chapter/Section																						
203.0			X	X	X						X	X	X	X	X	X						
204.0			X	X	X						X	X	X	X	X	X						
206.0				X	X																	
207.0			X	X	X						X	X	X	X	X	X						
208.0			X	X				X	X													
209.0	X		X				X	X	X													
210.0											X	X	X	X	X	X						
214.0			X	X	X																	
215.0			X																			
216.0				X	X																	
217.0			X	X	X																	
218.0				X	X																	
220.0			X																			
222.0				X	X																	
223.0			X	X	X						X	X	X	X	X	X						
228.0											X		X	X	X	X						

*This state agency does not adopt sections identified with the following symbol: †
The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.*

Nonhazardous Process Piping (NPP). Production material piping or tubing conveying a liquid or gas that is not classified as hazardous production material piping.

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

Notes:

1. For applications subject to the Mobilehome Parks Act as referenced in Section 1.8.3.2.2 of this code, refer to California Code of Regulations, Title 25, Division 1, Chapter 2 for the definition of “Nuisance”.
2. For applications subject to the Special Occupancy Parks Act as referenced in Section 1.8.3.2.3 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, Nontransient. Occupancy of a dwelling unit or sleeping unit for more than 30 days. [ASHRAE 62.1:3]

Occupancy Classification. Classifications are defined in the building code. **[HCD 1, HCD 2 & SFM]** Whenever the term “Building Code” is used in this code, it shall mean the California Building Code, Title 24, Part 2.

Occupational Exposure Limit (OEL). The time-weighted average (TWA) concentration for a normal 8-hour workday and a 40-hour workweek to which nearly all workers can be repeatedly exposed without adverse effect, based on the OSHA PEL, ACGIH TLV-TWA, TERA OARS-WEEL, or consistent value. [ASHRAE 34:3]

Occupiable Space. An enclosed space intended for human activities, excluding spaces that are intended to be occupied occasionally and for short periods of time, such as storage rooms, equipment rooms, and emergency exitways. [ASHRAE 62.1:3]

Open Combustible Construction. Combustible building construction, including wall, structural framing, roof, roof ceiling, floor, and floor-ceiling assemblies, adjacent to a grease duct on three or fewer sides where one or more sides require protection in accordance with Section 507.4.

218.0

– P –

Package Boiler. A class of boiler defined herein and shall be a boiler equipped and shipped complete with fuel-burning equipment, automatic controls and accessories, and mechanical draft equipment.

PE. Polyethylene.

PE-AL-PE. Polyethylene-aluminum-polyethylene.

PE-RT. Polyethylene of raised temperature.

PEL (Permissible Exposure Limit). The time-weighted average concentration [set by the U.S. Occupational Safety and Health Administration (OSHA)] for a normal 8-hour

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

PEX. Cross-linked polyethylene.

PEX-AL-PEX. Cross-linked polyethylene-aluminum-cross-linked polyethylene.

Pilot. A burner smaller than the main burner that is ignited by a spark or other independent and stable ignition source, and that provides ignition energy required to immediately light off the main burner.

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.

Pitched. To be fixed or set at a desired angle or inclination. [NFPA 96:3.3.39]

Plenum. An air compartment or chamber including uninhabited crawl space areas above a ceiling or below a floor, including air spaces below raised floors of computer/data processing centers or attic spaces, to one or more ducts are connected and that forms part of either the supply-air, return-air, or exhaust-air system, other than the occupiable 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 & 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 (hp) (2.2 kW) 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.

DEFINITIONS

Power Boiler. A boiler in which steam is generated at pressures exceeding 15 psi (103 kPa).

Power Boiler Plant. One or more power steam boilers or power hot water boilers and connecting piping and vessels within the same premises.

Power Hot Water Boiler (High Temperature Water Boiler). A boiler used for heating water or liquid to a pressure exceeding 160 psi (1103 kPa) or to a temperature exceeding 250°F (121°C).

PP. Polypropylene.

Pressure, Design. The maximum working pressure for which a specific part of a refrigeration system is designed.

Pressure, Field Test. A test performed in the field to prove system tightness.

Pressure-Imposing Element. A device or portion of the equipment used for the purpose of increasing the pressure of the refrigerant vapor.

Pressure-Limiting Device. A pressure-responsive mechanism designed to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

Pressure-Relief Device. A pressure-actuated valve or rupture member or fusible plug designed to automatically relieve excessive pressure.

Pressure Test. The minimum gauge pressure to which a specific system component is subjected under test condition.

Pressure Vessel (Unfired). A closed container, having a nominal internal diameter exceeding 6 inches (152 mm) and a volume exceeding 1½ cubic feet (0.04 m³), for liquids, gases, vapors subjected to pressures exceeding 15 psi (103 kPa), or steam under a pressure.

Pressure Vessel, Refrigerant. A refrigerant-containing receptacle that is a portion of a refrigeration system, but shall not include evaporators, headers, or piping of certain limited size and capacity.

Process Piping. Piping or tubing that conveys liquid or gas, which is used directly in research, laboratory, or production processes.

Product-Conveying Duct. Ducting used for conveying solid particulates, such as refuse, dust, fumes, and smoke; liquid particulate matter, such as spray residue, mists, and fogs; vapors, such as vapors from flammable or corrosive liquids; noxious and toxic gases; and air at temperatures exceeding 250°F (121°C).

Purge. The acceptable method of scavenging the combustion chamber, boiler passes, and breeching to remove combustible gases.

PVC. Polyvinyl chloride.

219.0 – Q –

Qualified. A competent and capable person or company that has met the requirements and training for a given field acceptable to the Authority Having Jurisdiction.

Quick-Disconnect Device, Fuel Gas. A hand-operated device that provides a means for connecting and disconnect-

ing an appliance or an appliance connector to a gas supply and that is equipped with an automatic means to shut off the gas supply when the device is disconnected. [NFPA 54:3.3.28.3]

220.0 – R –

Radiant Room Heater. A room heater designed to transfer heat primarily by direct radiation. [NFPA 211:3.3.88.2.2]

Receiver, Liquid. A vessel permanently connected to a refrigeration system by inlet and outlet pipes for storage of liquid.

Recirculating Systems. Systems for control of smoke or grease-laden vapors from commercial cooking equipment that do not exhaust to the outside. [NFPA 96:3.3.41]

Reclaimed Refrigerants. Refrigerants reprocessed to the same specifications as new refrigerants by any means, including distillation. Such refrigerants have been chemically analyzed to verify that those specifications have been met. [ASHRAE 15:3]

Recovered Refrigerants. Refrigerants removed from a system in any condition without necessarily testing or processing them. [ASHRAE 15:3]

Recycled Refrigerants. Refrigerants for which contaminants have been reduced by oil separation, removal of non-condensable gases, and single or multiple passes through filter driers or other devices that reduce moisture, acidity, and particulate matter. [ASHRAE 15:3]

Refrigerant. *A chemical compound intended to be used for heat transfer in a refrigerating system.*

Refrigerant Concentration Limit (RCL). *[SFM] The refrigerant concentration limit, in air, determined in accordance with this code and intended to reduce the risks of acute toxicity, asphyxiation, and flammability hazards in normally occupied, enclosed spaces. [ASHRAE 34:3.1]*

Refrigerant Designation. The unique identifying alphanumeric value assigned to an individual refrigerant.

Refrigerant Safety Classifications. Made up of a letter (A or B), that indicates the toxicity class, followed by a number (1, 2, 2L or 3), that indicates the flammability class. Refrigerant blends are similarly classified, based on the compositions at their worst cases of fractionation, as separately determined for toxicity and flammability. In some cases, the worst case of fractionation is the original formulation.

Flammability Classification. Refrigerants shall be classified for flammability in accordance with one of the following:

Class 1. Refrigerants that do not show flame propagation where tested in air at 14.7 pound-force per square inch absolute (psia) (101 kPa) and 140°F (60°C).

Class 2. Refrigerants having a lower flammability limit (LFL) of more than 0.00625 pound per cubic foot (lb/ft³) (0.10012 kg/m³) at 140°F (60°C), 14.7 psia (101 kPa), and a heat of combustion of less than 8169 British thermal units per pound (Btu/lb) (1.8988 E+07 J/kg).

Class 2L. Refrigerants having a lower flammability limit (LFL) of more than 0.00625 pound per cubic foot (lb/ft³) (0.10012 kg/m³) at 140°F (60°C), 14.7 psia (101 kPa), a heat of combustion of less than 8169 British thermal units per pound (Btu/lb) (1.8988 E+07 J/kg), and a maximum burning velocity of 3.9 inches per second (10 cm/s) where tested at 73.4°F (23°C) and 14.7 psia (101 kPa) in dry air.

Class 3. Refrigerants that are highly flammable having a LFL of not more than 0.00625 lb/ft³ (0.10012 kg/m³) at 140°F (60°C) and 14.7 psia (101 kPa) or a heat of combustion not less than 8169 Btu/lb (1.8988 E+07 J/kg).

Toxicity Classification. Refrigerants shall be classified for the toxicity in accordance with one of the following:

Class A. Refrigerants have an occupational exposure limit (OEL) of not less than 400 parts per million (ppm).

Class B. Refrigerants have an OEL of less than 400 ppm.

Refrigeration Machinery Room. A room designed to house compressors and refrigerant pressure vessels.

Refrigeration Room or Space. A room or space in which an evaporator or brine coil is located for the purpose of reducing or controlling the temperature within the room or space to less than 68°F (20°C).

Refrigeration System, Absorption. A heat-operated closed refrigeration cycle in which a secondary fluid, the absorbent, absorbs a primary fluid, the refrigerant that has been vaporized in the evaporator.

Refrigeration System, Direct. A system in which the evaporator or condenser of the refrigerating system is in direct contact with the air or other substances to be cooled or heated. [ASHRAE 15:5.1.1]

Refrigeration System, Indirect. A system in which a secondary coolant cooled or heated by the refrigerating system is circulated to the air or other substance to be cooled or heated. Indirect systems are distinguished by the method of application given below. [ASHRAE 15:5.1.2]

Indirect Open Spray System. A system in which a secondary coolant is in direct contact with the air or other substance to be cooled or heated. [ASHRAE 15:5.1.2.1]

Double Indirect Open Spray System. A system in which the secondary substance for an indirect open spray system is heated or cooled by the secondary coolant circulated from a second enclosure. [ASHRAE 15:5.1.2.2]

Indirect Closed System. A system in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated. [ASHRAE 15:5.1.2.3]

Refrigeration System, Mechanical. A combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat and in which a compressor is used for compressing the refrigerant vapor.

Refrigeration System, Self-Contained. A complete factory-assembled and tested system that is shipped in one or more sections and has no refrigerant-containing parts that are joined in the field by other than companion or block valves.

Registered Design Professional. An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.

Relief Valve, Vacuum. A device which automatically opens or closes for relieving a vacuum with the system, depending on whether the vacuum is above or below a predetermined value.

Removable. Capable of being transferred to another location with a limited application of effort and tools. [NFPA 96:3.3.42]

Replacement Air. See Air, Makeup.

Residential Building. A building or portion thereof designed or used for human habitation.

Riser Heat Pipe. A duct that extends at an angle of 45 degrees (0.79 rad) from the horizontal. This definition shall not include any boot connection.

Room Heater. A freestanding, nonrecessed, environmental heating appliance installed in the space being heated and not connected to ducts.

Room Heater, Unvented. An unvented, self-contained, freestanding, nonrecessed, fuel gas-burning appliance for furnishing warm air by gravity or fan circulation to the space in which installed, directly from the heater without duct connection. [NFPA 54:3.3.56.6]

Rupture Member. A pressure-relief device that operates by the rupture of a diaphragm within the device on a rise to a predetermined pressure.

221.0 – S –

Seam, Welded. See Joint, Welded.

Secondary Filtration. Fume incinerators, thermal recovery units, air pollution control devices or other filtration media installed in ducts or hoods located in the path of travel of exhaust products after the initial filtration.

Self-Contained. Having all essential working parts, except energy and control connections, so contained in a case or framework that they do not depend on appliances or fastenings outside of the machine.

Service Corridor. A fully enclosed passage used for transporting hazardous production materials and purposes other than required exiting.

Service Piping. The piping and equipment between the street gas main and the gas piping system inlet that is installed by, and is under the control and maintenance of, the serving gas supplier.

Shaft. An interior space enclosed by walls or construction extending through one or more stories or basements that connect openings in successive floors, or floors and roof, to accommodate elevators, dumbwaiters, mechanical equipment, or similar devices to transmit light or ventilation air.

DEFINITIONS

Shaft Enclosure. The walls or construction forming the boundaries of a shaft.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Single Hazard Area. Where two or more hazards can be simultaneously involved in fire by reason of their proximity, as determined by the Authority Having Jurisdiction. [NFPA 96:3.3.44]

Smoke Detector. An approved device that senses visible or invisible particles of combustion.

Solid Cooking Fuel. A solid, organic, consumable fuel such as briquettes, mesquite, hardwood, or charcoal. [NFPA 96:3.3.45]

Solid-Fuel Cooking Equipment. Cooking equipment that utilizes solid fuel. [NFPA 96:3.3.23.2] This equipment includes ovens, tandoori charcoal pots, grills, broilers, rotisseries, barbecue pits, or other type of cooking equipment that derives all or part of its heat source from the burning of solid cooking fuel.

Solvent. A substance (usually liquid) capable of dissolving or dispersing another substance; a chemical compound designed and used to convert solidified grease into a liquid or semiliquid state in order to facilitate a cleaning operation. [NFPA 96:3.3.46]

Spark Arrester. A device or method that minimizes the passage of airborne sparks and embers into a plenum, duct, and flue. [NFPA 96:3.3.48]

Standard. A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

Stationary Fuel Cell Power Plant. A self-contained package or factory-matched packages that constitute an automatically operated assembly of integrated systems for generating useful electrical energy and recoverable energy that is permanently connected and fixed in place.

Steam-Heating Boiler. A boiler operated at pressures not exceeding 15 psi (103 kPa) for steam.

Strength, Ultimate. The highest stress level that the component can tolerate without rupture.

System Outdoor Airflow. The rate of outdoor airflow required at the ventilation system outdoor air intake.

222.0

– T –

Termination, Duct. The final or intended end portion of a duct system that is designed and functions to fulfill the obligations of the system in a satisfactory manner. [NFPA 96:3.3.19]

Testing Agency. [HCD 1 & HCD 2] See “Approved Testing Agency”.

Thermal Recovery Unit. A device or series of devices whose purpose is to reclaim only the heat content of air, vapors, gases, or fluids that are being expelled through the

exhaust system and to transfer the thermal energy so reclaimed to a location whereby a useful purpose can be served. [NFPA 96:3.3.49]

Trained. A person who has become proficient in performing a skill reliably and safely through instruction and practice/field experience acceptable to the Authority Having Jurisdiction. [NFPA 96:3.3.50]

Transition Gas Riser. A listed or approved section or sections of pipe and fittings used to convey fuel gas and installed in a gas piping system for the purpose of providing a transition from belowground to aboveground.

Trap. A cuplike or U-shaped configuration located on the inside of a duct system component where liquids can accumulate. [NFPA 96:3.3.51]

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

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

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

223.0

– U –

UMC. [HCD 1, HCD 2, OSHPD 1, 1R, 2, 3, 4 & 5] *The most recent edition of Uniform Mechanical Code published by the International Association of Plumbing and Mechanical Officials.*

Unit Heater. A heating appliance designed for nonresidential space heating and equipped with an integral means for circulation of air.

Unusually Tight Construction. Construction where:

- (1) Walls and ceilings exposed to the outdoors have a continuous water vapor retarder with a rating of 1 perm or less with openings gasketed or sealed.
- (2) Weatherstripping is on openable windows and doors.
- (3) Caulking or sealants are applied to areas such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, and at penetrations for plumbing, electrical, and gas lines and at other openings.

Use (Material). The placing in action or making available for service by opening or connecting a container utilized for confinement of material, whether a solid, liquid, or gas.

224.0

– V –

Vacuum. A pressure less than that exerted by the atmosphere.

Valve, Pressure-Relief. A pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Valve, Stop. A device in a piping system to shut off the flow of the fluid.

Valve, Three-Way-Type Stop. A manually operated valve with one inlet that alternately can stop flow to either of two outlets.

Valves, Companion or Block. Pairs of mating stop valves valving off sections of refrigeration systems and arranged so that these sections may be joined before opening these valves or separated after closing them.

Vent, Gas. A passageway composed of listed factory-built components assembled in accordance with the manufacturer’s installation instructions for conveying vent gases from appliances or their vent connectors to the outdoors. [NFPA 54:3.3.53]

Vent Connector, Gas. That portion of a gas-venting system that connects a listed gas appliance to a gas vent and is installed within the space or area in which the appliance is located.

Vent Offset. An arrangement of two or more fittings and pipe installed for the purpose of locating a vertical section of vent pipe in a different but parallel plane with respect to an adjacent section of vertical vent pipe. [NFPA 54:3.3.102]

Vented Appliance Categories.

Category I. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. [NFPA 54:3.3.5.11.1]

Category II. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that can cause excessive condensate production in the vent. [NFPA 54:3.3.5.11.2]

Category III. An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. [NFPA 54:3.3.5.11.3]

Category IV. An appliance that operates with a positive vent static pressure and with a vent gas temperature that can cause excessive condensate production in the vent. [NFPA 54:3.3.5.11.4]

Vented Decorative Appliance. A vented appliance whose only function is providing an aesthetic effect of flames.

Vented Wall Furnace. A self-contained, vented, fuel gas-burning appliance complete with grilles or equivalent, designed for incorporation in or permanent attachment to the structure of a building and furnishing heated air, circulated by gravity or by a fan, directly into the space to be heated through openings in the casing. [NFPA 54:3.3.45.7]

Ventilating Ceiling. A suspended ceiling containing many small apertures through which air, at low pressure, is forced downward from an overhead plenum dimensioned by the concealed space between the suspended ceiling and the floor or roof above.

Ventilation System. All of that equipment intended or installed for the purpose of supplying air to or removing air from, any room or space by mechanical means, other than equipment that is a portion of an environmental heating, cooling, absorption, or evaporative cooling system.

Venting Collar. The outlet opening of an appliance provided for connection of the vent system.

Venting System. The vent or chimney and its connectors, assembled to form a continuous open passageway from an appliance to the outdoors for the purpose of removing products of combustion. This definition also shall include a venting assembly that is an integral part of an appliance.

Venting System, Gravity-Type. A system that depends entirely on the heat from the fuel being used to provide the energy required to vent an appliance.

Venting System, Power-Type. A system that depends on a mechanical device to provide a positive draft within the venting system.

Volume, Internal Gross. The volume as determined from internal dimensions of the container, with no allowance for the volume of the internal parts.

225.0 – W –

Wall Heater. See Vented Wall Furnace.

Warm Air Furnace. An environmental heating appliance designed or arranged to discharge heated air through any duct or ducts. This definition shall not include a unit heater.

Water Heater or Hot-Water-Heating Boiler. An appliance designed primarily to supply hot water for domestic or commercial purposes and equipped with automatic controls limiting water temperature to a maximum of 210°F (99°C).

226.0 – X –

No definitions.

227.0 – Y –

No definitions.

228.0 – Z –

Zeotropic. Blends comprising multiple components of different volatilities that, when used in refrigeration cycles, change volumetric composition and saturation temperatures as they evaporate or condense at constant pressure. [ASHRAE 34:3]

Zone. [OSHPD 1, 2, 3, 4 & 5] *A space or group of spaces within a building for which the heating, or cooling requirements are sufficiently similar that desired conditions can be maintained throughout by a single controlling device.*

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 3 – GENERAL REGULATIONS**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter	X																						
Adopt Entire Chapter as amended (amended sections listed below)			X	X	X			X	X	X	X	X	X	X									
Adopt only those sections that are listed below																				X			
Chapter/Section																							
301.7											X												
303.2											†	†	†	†	†	†							
303.7			X					X	X														
303.7.1				X	X																		
305.2 Exception				X	X																		
306.2											X												
307.3			X																				
307.4			X																				
311.5																				X			
312.1				X	X			X	X														
316.2				X	X																		
316.5				X	X																		
316.9				X	X																		
318.0											X	X	X	X	X	X							
319.1											X	X			X	X							
319.2												X			X								
320.1											X	X			X	X							
320.2												X			X								
320.3													X										
320.4											X				X								
320.4.4											X				X								
320.5											X	X	X		X	X							
321.0											X	X	X	X	X	X							
322.0											X	X	X	X	X	X							
322.1											X		X	X	X								
323.0											X	X	X		X	X							
324.0											X	X	X	X	X	X							
325.0												X											

This state agency does not adopt sections identified with the following symbol: †

The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.

305.0 Location.

305.1 Installation in Residential Garages. Appliances in residential garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit shall be installed so that all burners and burner-ignition devices are located not less than 18 inches (457 mm) above the floor unless listed as flammable vapor ignition resistant. [NFPA 54:9.1.10.1]

305.1.1 Physical Damage. Appliances installed in garages, warehouses, or other areas subject to mechanical damage shall be guarded against such damage by being installed behind protective barriers or by being elevated or located out of the normal path of vehicles.

305.1.2 Access from the Outside. Where appliances are installed in a separate, enclosed space having access only from outside of the garage, such appliances shall be permitted to be installed at floor level, providing the required combustion air is taken from the exterior of the garage. [NFPA 54:9.1.10.3]

305.1.3 Cellulose Nitrate Plastic Storage. Heating equipment located in rooms where cellulose nitrate plastic is stored or processed shall be in accordance with the fire code.

» **305.2 Pit Location.** Where excavation is necessary to install an appliance, the depth shall extend not less than 6 inches (152 mm) below and 12 inches (305 mm) on all sides of the appliance, except on the service side, which shall have 30 inches (762 mm). Where the depth of the excavation for either the appliance or passageway exceeds 12 inches (305 mm), walls shall be lined with concrete or masonry 4 inches (102 mm) above the adjoining ground level.

Exception: [HCD 1 & HCD 2] *Liquefied petroleum gas (LP-Gas) appliances as described in Section 303.7.1.*

» **305.3 Flood Hazard Areas.** For buildings located in flood hazard areas, heating, ventilating, air-conditioning, refrigeration, miscellaneous heat-producing, and energy-utilizing equipment and appliances shall be elevated at or above the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher.

Exception: Equipment and appliances shall be permitted to be located below the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher, provided that the systems are designed and installed to prevent water from entering or accumulating within their components and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to such elevation.

» **305.3.1 Coastal High Hazard Areas.** Mechanical systems in buildings located in coastal high hazard areas shall be in accordance with the requirements of Section 305.3, and mechanical systems, pipes, and appurtenances shall not be mounted on or penetrate through walls that

are intended to breakaway under flood loads in accordance with the building code.

305.3.2 Air Exhaust and Intake Openings. Outside air exhaust openings and air intake openings shall be located at or above the elevation required by the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher. <<

305.4 Elevator Shaft. Unless required for the functionality and safety of the elevator system, mechanical systems shall not be located in an elevator shaft. <<

305.5 Drainage Pan. Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, or floor-subfloor assembly where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater with not less than ¾ of an inch (20 mm) diameter drain to an approved location. Such pan shall be not less than 1½ inches (38 mm) in depth. <<

306.0 Automatic Control Devices.

306.1 General. Heating appliances shall be equipped with a listed device or devices that will shut off the fuel supply to the main burner or burners in the event of pilot or ignition failure. Liquefied petroleum gas-air-burning heating appliances shall be equipped with a listed automatic device or devices that will shut off the flow of gas to the pilot in the event of ignition failure.

Exception: The listed shutoff devices shall not be required on range or cooking tops, log lighters, lights, or other open-burner manually operated appliances, or listed appliances not requiring such devices and specific industrial appliances as approved by the Authority Having Jurisdiction.

Heating appliances whose manual fuel controls are not readily accessible from the main portion of the building being heated shall be equipped with remote controls.

Forced-air and gravity-type warm air furnaces shall be equipped with a listed air outlet temperature limit control that cannot be set for temperatures exceeding 250°F (121°C). Such controls shall be located in the bonnet or plenum, within 2 feet (610 mm) of the discharge side of the heating element of gravity furnaces or in accordance with the conditions of listing.

Electric duct heaters shall be equipped with an approved automatic reset air outlet temperature limit control that will limit the outlet air temperature to not exceed 200°F (93°C). The electric elements of the heater shall be equipped with fusible links or a manual reset temperature limit control that will prevent outlet air temperature in excess of 250°F (121°C).

306.2 Building Automation Systems. [OSHPD 1] *Building automation systems shall provide for localized control in the event of network failure. This capability shall be specified in the construction documentation.*

307.0 Labeling.

307.1 Fuel-Burning Appliances. Fuel-burning heating appliances shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The approved fuel input rating of the appliance, expressed in Btu/h (kW).
- (3) The model number or equivalent.
- (4) The serial number.
- (5) Instructions for the lighting, operation, and shutdown of the appliance.
- (6) The type of fuel approved for use with the appliance.
- (7) The symbol of an approved agency certifying compliance of the equipment with recognized standards.
- (8) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

307.2 Electric Heating Appliances. Electric heating appliances shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- (4) The electrical rating in volts, amperes (or watts), and, for other than single phase, the number of phases.
- (5) The output rating in Btu/h (kW).
- (6) The electrical rating in volts, amperes, or watts of each field-replaceable electrical component.
- (7) The symbol of an approved agency certifying compliance of equipment with recognized standards.
- (8) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

An appliance shall be accompanied by clear and complete installation instructions, including required clearances from combustibles other than mounting or adjacent surfaces, and temperature rating of field-installed wiring connections exceeding 140°F (60°C).

307.3 Heat Pump and Electric Cooling Appliances. Heat pumps and electric cooling appliances shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- || (4) The amount of refrigerant.
- || (5) *The refrigerant designation.*
- || (6) The factory test pressures or pressures applied.
- || (7) The electrical rating in volts, amperes, and, for other than single phase, the number of phases.
- || (8) The output rating in Btu/h (kW).
- || (9) The electrical rating in volts, amperes, or watts of each field replaceable electrical component.

(10) The symbol of an approved agency certifying compliance of the equipment with recognized standards.

(11) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

An appliance shall be accompanied by clear and complete installation instructions, including required clearances from combustible other than mounting or adjacent surfaces, and temperature rating of field-installed wiring connections exceeding 140°F (60°C).

307.4 Absorption Units. Absorption units shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- (4) The amount of refrigerant. ||
- (5) *The refrigerant designation.* ||
- (6) Hourly rating in Btu/h (kW). ||
- (7) The type of fuel approved for use with the unit. ||
- (8) Cooling capacity Btu/h (kW). ||
- (9) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted. ||
- (10) The symbol of an approved agency certifying compliance of the equipment with recognized standards. ||

308.0 Improper Location.

308.1 General. Piping or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

309.0 Workmanship.

309.1 Engineering Practices. Design, construction, and workmanship shall comply with accepted engineering practices and shall be of such character as to secure the results sought to be obtained by this code.

309.2 Concealing Imperfections. It shall be unlawful to conceal cracks, holes, or other imperfections in materials by welding, brazing, or soldering, by using therein or thereon paint, wax, tar, solvent cement, other leak-sealing or repair agent.

309.3 Installation Practices. Mechanical systems shall be installed in a manner that is in accordance with this code, applicable standards, and the manufacturer’s installation instructions.

310.0 Condensate Wastes and Control.

310.1 Condensate Disposal. Condensate from air washers, air-cooling coils, condensing appliances, and the overflow from evaporative coolers and similar water-supplied equipment or similar air-conditioning equipment shall be collected and discharged to an approved plumbing fixture or disposal area. Where discharged into the drainage system, equipment shall drain by means of an indirect waste pipe. The

314.0 Balancing.

314.1 General. Heating, ventilating, and air-conditioning systems (including hydronic systems) shall be balanced in accordance with one of the following methods:

- (1) AABC National Standards for Total System Balance
- (2) ACCA Manual B
- (3) ASHRAE 111
- (4) NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems
- (5) SMACNA HVAC Systems Testing, Adjusting, and Balancing

315.0 Louvers in Hurricane Prone Regions.

315.1 General. Louvers located in areas within hurricane-prone regions that are within 1 mile (2 km) of the coastal mean high water line where the basic wind speed is 110 miles per hour (mi/h) (49.2 m/s) or more; or portions of hurricane-prone regions where the basic wind speed is 120 mi/h (53.6 m/s) or more; or Hawaii, as described in ASCE 7 shall be tested in accordance with Section 315.1.1 and Section 315.1.2.

315.1.1 Testing. Louvers that protect air intake or exhaust openings shall be tested in accordance with AMCA 550 for resistance to wind-driven rain.

315.1.2 Impact Resistance Test. Upon request by the Authority Having Jurisdiction, louvers protecting intake and exhaust ventilation ducts that are not fixed in the open position and located within 30 feet (9144 mm) of the grade shall be tested for impact resistance in accordance with AMCA 540.

316.0 Protection of Piping, Tubing, Materials, and Structures.

316.1 General. Piping or tubing passing under or through walls shall be protected from breakage. Piping passing through or under cinders or other corrosive materials shall be protected from external corrosion in an approved manner. Approved provisions shall be made for expansion of hot water piping. Voids around piping or tubing passing through concrete floors on the ground shall be sealed.

316.2 Installation. Piping or tubing shall be installed so that the piping, tubing, or connections will not be subject to undue strains or stresses, and provisions shall be made for expansion, contraction, and structural settlement. No piping or tubing, unless designed and listed for such use, shall be directly embedded in concrete or masonry. No structural member shall be seriously weakened or impaired by cutting, notching, or otherwise as defined in the *California Building Code or California Residential Code*.

316.3 Corrosion, Erosion, and Mechanical Damage. Piping or tubing subject to corrosion, erosion, or mechanical damage shall be protected in an approved manner.

316.4 Protectively Coated Pipe. Protectively coated pipe or tubing shall be inspected and tested, and a visible void, damage, or imperfection to the pipe coating shall be repaired in an approved manner.

316.5 Fire-Resistant Construction. Piping, tubing, and duct system penetrations of fire-resistance-rated walls, partitions, floors, floor/ceiling assemblies, roof/ceiling assemblies, or shaft enclosures shall be protected in accordance with the requirements of the *California Building Code or California Residential Code*.

316.6 Steel Nail Plates. Plastic piping or tubing, copper or copper alloy piping or tubing, and ducts penetrating framing members to within 1 inch (25.4 mm) of the exposed framing shall be protected by steel nail plates not less than No. 18 gauge (0.0478 inches) (1.2141 mm) in thickness. The steel nail plate shall extend along the framing member not less than 1½ inches (38 mm) beyond the outside diameter of the pipe or tubing.

Exception: See Section 1310.4.3.

316.7 Sleeves. Sleeves shall be provided to protect piping through concrete and masonry walls and concrete floors.

Exception: Sleeves shall not be required where openings are drilled or bored.

316.7.1 Building Loads. Piping or tubing through concrete or masonry walls shall not be subject to a load from building construction.

316.7.2 Exterior Walls. In exterior walls, annular space between sleeves and pipes or tubing shall be sealed and made watertight, as approved by the Authority Having Jurisdiction. A penetration through fire-resistive construction shall be in accordance with Section 316.5.

316.8 Firewalls. A pipe sleeve through a firewall shall have the space around the pipe or tubing completely sealed with an approved fire-resistive material in accordance with other codes.

316.9 Structural Members. A structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in a safe structural condition in accordance with the requirements of the *California Building Code or California Residential Code*.

316.10 Rodentproofing. Mechanical system shall be constructed in such a manner as to restrict rodents or vermin from entering a building by following the ductwork from the outside into the building.

316.11 Metal Collars. In or on buildings where openings have been made in walls, floors, or ceilings for the passage of ductwork or pipes, such openings shall be closed and protected by the installation of approved metal collars securely fastened to the adjoining structure.

317.0 Trenching, Excavation, and Backfill.

317.1 Trenches. Trenches deeper than the footings of a building or structure, and paralleling the same, shall be located not less than 45 degrees (0.79 rad) from the bottom exterior edge of the footing, or as approved in accordance with Section 302.0.

317.2 Tunneling and Driving. Tunneling and driving shall be permitted to be done in yards, courts, or driveways of a building site. Where sufficient depth is available to permit, tunnels shall be permitted to be used between open-cut

trenches. Tunnels shall have a clear height of 2 feet (610 mm) above the pipe and shall be limited in length to one-half the depth of the trench, with a maximum length of 8 feet (2438 mm). Where pipes are driven, the drive pipe shall be not less than one size larger than the pipe to be laid.

317.3 Open Trenches. Excavations required to be made for the installation of a mechanical system or part thereof, within the walls of a building, shall be open trench work and shall be kept open until it has been inspected, tested, and accepted.

317.4 Excavations. Excavations shall be completely back-filled as soon after inspection as practicable. Precaution shall be taken to ensure compactness of backfill around piping without damage to such piping. Trenches shall be backfilled in thin layers to 12 inches (305 mm) above the top of the piping with clean earth, which shall not contain stones, boulders, cinderfill, frozen earth, construction debris, or other materials that will damage or break the piping or cause corrosive action. Mechanical devices such as bulldozers, graders, etc., shall be permitted to then be used to complete backfill to grade. Fill shall be properly compacted. Precautions shall be taken to ensure permanent stability for pipe laid in filled or made ground.

318.0 Scope.

318.1 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.*

318.2 Services/Systems and Utilities. *Refer to Section 1224.4.1, 1225.2.1 and 1228.4.1.1 of the California Building Code.*

319.0 Steam and Hot-Water Systems.

319.1 Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers. [OSHPD 1, 1R, 4 & 5]

319.1.1 *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.*

319.1.2 *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.*

319.1.3 *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 4-A for sensitive areas during periods of breakdown or maintenance of any one boiler.*

319.1.4 *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.

319.1.5 *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.*

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

319.2.1 *Boilers, if provided, shall accommodate Section 319.1.*

319.2.2 *Two or more interconnected water heaters are an acceptable means to provide two sources of heat for hot water (See Section 319.1.5).*

320.0 Air Conditioning and Heating Systems.

320.1 Requirements for Hospitals and Optional Services Provided in Correctional Treatment Centers. [OSHPD 1, 1R, 4 & 5]

320.1.1 *The systems shall be designed to provide the temperatures and relative humidity for sensitive areas or rooms shown in Table 4-A. When outdoor humidity and internal moisture sources are not sufficient to meet the requirements of sensitive areas or rooms in Table 4-A, humidification shall be provided by means of the health-care facility air-handling systems. Temperature shall be individually controlled for each operating and delivery room. Burn unit patient rooms that require humidifiers to comply with the requirements of sensitive areas or rooms in Table 4-A shall be provided with individual humidity control. Humidifiers shall be of the dry steam or adiabatic atomizing type. Adiabatic atomizing humidifiers shall comply with the water treatment requirements in accordance with ASHRAE 170. Humidifiers shall be located within air handling systems or ductwork to avoid moisture accumulation in downstream components, including filters and insulation.*

320.1.2 *Heating systems shall be designed based on the "Heating DB 99.6%" column of the Climatic Design Data in ASHRAE Handbook-Fundamentals. The systems shall be thermostatically controlled with appropriate zoning to achieve the above conditions.*

320.1.3 *Cooling systems shall be designed based on the 0.4% columns of the four Annual Design Conditions titled Cooling, Evaporation, Dehumidification, and Enthalpy shown by the Climate Design Data in ASHRAE Handbook-Fundamentals. The systems shall be thermostatically controlled with appropriate zoning to achieve the above conditions.*

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

320.2.1 *Systems shall accommodate the provisions of Sections 320.1.2 through 320.1.3.*

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

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

320.3.1 The system shall be designed to provide the temperature and humidities for sensitive areas for rooms shown in Table 4-A.

320.4 Telephone and Technology Equipment Centers. [OSHPD 1 & 4] Where telecommunications service entrance rooms, technology equipment centers, or technology distribution rooms are provided in accordance with Section 1224.5 of the California Building Code, the following requirements shall apply:

320.4.1 Power for HVAC systems serving the room(s) shall be supplied by the Equipment Branch pursuant to the California Electrical Code. Where redundant systems are provided, only one shall be required to be supplied by the Equipment Branch.

320.4.2 Mechanical equipment or fixtures that are not directly related to the support of the room shall not be installed in or pass through the room.

Exception: Unrelated ductwork may be installed and shall be not less than 10 feet (3048 mm) above the finished floor.

320.4.3 HVAC systems shall be provided to maintain environmental conditions recommended in ASHRAE's Thermal Guidelines for Data Processing Environment and the requirements of the specific equipment installed.

320.4.4 Technology equipment centers shall have redundant cooling systems each of sufficient capacity to provide required cooling during periods of breakdown or maintenance of either system. One system shall be non-hydronic and on essential power.

320.5 Psychiatric Services. [OSHPD 1, 1R, 2, 4 & 5] For projects associated with provision of psychiatric services in acute psychiatric hospitals, general acute-care hospitals, and special treatment program service units in skilled nursing facilities, psychiatric, seclusion, and holding-patient rooms shall be designed with security diffusers, grilles, and registers.

321.0 Essential Mechanical Provisions. [OSHPD 1, 1R, 2, 3 (Surgical Clinics only) 4 & 5] During periods of power outages essential electrical power shall be provided for the following equipment:

321.1 (Does not apply to OSHPD 3 surgical clinic.) All heating equipment and fans necessary to maintain a minimum temperature of 60°F (15.6°) in patient areas which are not specified in Section 322.0.

321.2 All heating equipment and fans necessary to maintain the minimum temperatures listed in Table 4-A for sensitive areas specified in Section 322.0.

321.3 Equipment necessary for humidification of the areas listed in Section 322.0.

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

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

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

322.0 Sensitive Areas or Rooms. [OSHPD 1, 1R, 2, 3 (Surgical Clinics) 4 & 5] The following are sensitive areas or rooms:

- (1) Operating room, hybrid operation room
- (2) Cystoscopy
- (3) Cardiac catheterization lab
- (4) Trauma/cardiac room
- (5) Delivery room, cesarean operating room
- (6) Gastrointestinal endoscopy procedure room
- (7) Post-anesthesia care unit
- (8) Newborn nursery
- (9) Newborn intensive-care nursery unit
- (10) Intensive care
- (11) Burn unit

322.1 The following conditions shall be met for sensitive areas or rooms:

- (1) Thermostats and humidistats shall be either locally resettable and of the non-locking type or remotely resettable and of the locking type.
- (2) Systems shall be capable of maintaining the rooms within the temperature range in Table 4-A during normal operation. Lower or higher temperature shall be permitted when patients' comfort and/or medical conditions require those conditions.
- (3) The humidity ranges listed in Table 4-A are the minimum and maximum limits where control is specifically needed.
- (4) Types of intensive care service spaces are listed in the California Building Code.

323.0 Mechanical Equipment Schedules. [OSHPD 1, 1R, 2, 4 & 5] Mechanical equipment schedules in the construction documents shall clearly indicate which equipment will be powered by essential power and which equipment includes the appropriate special seismic certifications.

324.0 Diesel-Powered Emergency Generators. [OSHPD 1, 1R, 2, 3, 4 & 5] The minimum horizontal separation distance between diesel-powered emergency electrical generator exhaust outlets and operable doors, windows and intake openings shall be 30 feet (9144 mm). The minimum horizontal distance from the generator exhaust to a property line shall be 15 feet (4572 mm) or per the requirements of the Authority Having Jurisdiction, whichever is greater.

325.0 Alternate Source of Power for Safe Temperatures. [OSHPD 2] Mechanical equipment required to maintain a safe temperature for residents shall be powered by an alternate source of power per California Electrical Code Section 517.1. The safe temperature shall be between 71°F to 81°F (21.6°C to 27.2°C).

GENERAL REGULATIONS

TABLE 303.10.1
REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION^{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
[NFPA 54: TABLE 10.2.3]

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE-WALL METAL PIPE IS:									
	36 (INCHES)		18 (INCHES)		12 (INCHES)		9 (INCHES)		6 (INCHES)	
	ALLOWABLE CLEARANCES WITH SPECIFIED PROTECTION (INCHES)									
	USE COLUMN 1 FOR CLEARANCES ABOVE APPLIANCE OR HORIZONTAL CONNECTOR. USE COLUMN 2 FOR CLEARANCES FROM APPLIANCES, VERTICAL CONNECTOR, AND SINGLE-WALL METAL PIPE.									
	ABOVE (COLUMN 1)	SIDES AND REAR (COLUMN 2)	ABOVE (COLUMN 1)	SIDES AND REAR (COLUMN 2)	ABOVE (COLUMN 1)	SIDES AND REAR (COLUMN 2)	ABOVE (COLUMN 1)	SIDES AND REAR (COLUMN 2)	ABOVE (COLUMN 1)	SIDES AND REAR (COLUMN 2)
(1) 3½ inch thick masonry wall without ventilated air space	—	24	—	12	—	9	—	6	—	5
(2) ½ of an inch insulation board over 1 inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
(3) 0.024 inch (nominal 24 gauge) sheet metal over 1 inch glass fiber or mineral wool batts reinforced with wire on rear face with ventilated air space	18	12	9	6	6	4	5	3	3	3
(4) 3½ inch thick masonry wall with ventilated air space	—	12	—	6	—	6	—	6	—	6
(5) 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	2
(6) ½ of an inch thick insulation board with ventilated air space	18	12	9	6	6	4	5	3	3	3
(7) 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space over 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	3
(8) 1 inch glass fiber or mineral wool batts sandwiched between two sheets 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	3

For SI units: 1 inch = 25.4 mm, °C = (°F-32)/1.8

Notes:

- ¹ Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.
- ² All clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the appliance, disregarding any intervening protection applied to the combustible material.
- ³ Spacers and ties shall be of noncombustible material. No spacer or tie shall be used directly opposite the appliance or connector.
- ⁴ Where all clearance reduction systems use a ventilated air space, adequate provision for air circulation shall be provided as described. [See Figure 303.10.1(2) and Figure 303.10.1(3)]
- ⁵ At least 1 inch (25.4 mm) shall be between clearance reduction systems and combustible walls and ceilings for reduction systems using a ventilated air space.
- ⁶ Where a wall protector is mounted on a single flat wall away from corners, it shall have a minimum 1 inch (25.4 mm) air gap. To provide adequate air circulation, the bottom and top edges, or only the side and top edges, or all edges shall be left open.
- ⁷ Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot (lb/ft³) (128 kg/m³) and a minimum melting point of 1500°F (816°C).
- ⁸ Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1 British thermal unit inch per hour square foot degree Fahrenheit [Btu•in/(h•ft²•°F)] [0.1W/(m•K)] or less.
- ⁹ At least 1 inch (25.4 mm) shall be between the appliance and the protector. In no case shall the clearance between the appliance and the combustible surface be reduced below that allowed in Table 303.10.1.
- ¹⁰ All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.
- ¹¹ Listed single-wall connectors shall be installed in accordance with the manufacturer’s installation instructions.

CHAPTER 4

VENTILATION AIR

401.0 General.

401.1 Applicability. This chapter contains requirements for ventilation air supply, exhaust, and makeup air requirements for occupiable spaces within a building. [OSHPD 1, 1R, 2, 3, 4 & 5] 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. Spaces within buildings, except those within a dwelling unit in residential occupancies where occupants are nontransient, shall comply with Section 402.0 through Section 404.0. Requirements for ventilation air rate for dwelling units in residential occupancies, where the occupants are nontransient, shall be in accordance with Section 405.0.

401.2 Filters. [BSC-CG], [DSA-SS & DSA-SS/CC] In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 13. MERV 13 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual in compliance with Chapter 5, Division 5.5. of the California Green Building Standards Code (CALGreen).

Exception: Existing mechanical equipment.

401.2.1 Labeling. Installed filters shall be clearly labeled by the manufacturer indicating the MERV rating.

402.0 Ventilation Air.

402.1 Occupiable Spaces. Occupiable spaces listed in Table 402.1 [OSHPD 1, 1R, 2, 3, 4 & 5] and Table 4-A shall be designed to have ventilation (outdoor) air for occupants in accordance with this chapter. [DSA-SS & DSA-SS/CC] Ventilation air requirements for occupancies regulated by the California Energy Commission are found in the California Energy Code.

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

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.

402.1.2 Ventilation in Health Care Facilities. Mechanical ventilation for health care facilities shall be designed and installed in accordance with this code and ASHRAE 170 [OSHPD 1, 1R, 2, 3, 4 & 5]-2013, through Addendum ae. Ventilation rates for areas not specified in Table 4-A shall have minimum ventilation and air change rates per ANSI/ASHRAE Standard 62.1.

Where areas with prescribed ventilation rates in both Standards 62.1 and Table 4-A exist, the higher of the two air change rates shall be used. All supply-air, return air, and exhaust-air systems shall comply with ASHRAE 170. The text of ASHRAE 170 shall be modified as follows:

- (1) ASHRAE 170. Section 6.1.2.1 -- Not adopted.
- (2) ASHRAE 170. Section 6.3.1.2 -- Modify as follows: Relief air discharge shall be at least 10 feet (3048 mm) from any outside air intake.
- (3) ASHRAE 170. Section 6.3.2 -- Not adopted.
- (4) ASHRAE 170. Table 6.4 -- Not adopted.
- (5) ASHRAE 170. Section 6.4-6.4.4 -- Not adopted.
- (6) ASHRAE 170. Section 6.9 -- Not adopted.
- (7) ASHRAE 170. Section 7.1a -- Modify as follows: Replace reference to Table 7.1 with reference to Table 4-A.
- (8) ASHRAE 170. Section 7.2.1a through e -- Not adopted.
- (9) ASHRAE 170. Section 7.2.2 a through c, and e -- Not adopted.
- (10) ASHRAE 170. Section 7.2.3 -- Not adopted.
- (11) ASHRAE 170. Section 7.3.1 -- Modify as follows: Replace reference to Table 7.1 with reference to Table 4-A.
- (12) ASHRAE 170. Section 7.4.1 -- Modify as follows: Delete the Exception that allows for high return grilles.

402.2 Natural Ventilation. [Not permitted for OSHPD 1, 2, 3, 4 & 5] Natural ventilation systems shall be designed in accordance with this section and shall include mechanical ventilation systems designed in accordance with Section 403.0, Section 404.0, or both.

Exceptions:

- (1) An engineered natural ventilation system where approved by the Authority Having Jurisdiction need not comply with Section 402.2.
- (2) The mechanical ventilation systems shall not be required where:
 - (a) natural ventilation openings that comply with the requirements of Section 402.2 and are permanently open or have controls that prevent the openings from being closed during periods of expected occupancy or
 - (b) the zone is not served by heating or cooling equipment. [ASHRAE 62.1:6.4]

402.2.1 Floor Area to be Ventilated. Spaces, or portions of spaces, to be naturally ventilated shall be located within a distance based on the ceiling height, as determined in accordance with Section 402.2.1.1, Section

402.2.1.2, or Section 402.2.1.3, from operable wall openings in accordance with the requirements of Section 402.2.2. For spaces with ceilings that are not parallel to the floor, the ceiling height shall be determined in accordance with Section 402.2.1.4. [ASHRAE 62.1:6.4.1]

402.2.1.1 Single Side Opening. For spaces with operable openings on one side of the space, the distance from the operable openings shall be not more than $2H$, where H is the ceiling height. [ASHRAE 62.1:6.4.1.1]

402.2.1.2 Double Side Opening. For spaces with operable openings on two opposite sides of the space, the distance from the operable openings shall be not more than $5H$, where H is the ceiling height. [ASHRAE 62.1:6.4.1.2]

402.2.1.3 Corner Openings. For spaces with operable openings on two adjacent sides of a space, the distance from the operable openings shall be not more than $5H$ along a line drawn between the two openings that are farthest apart. Floor area outside that line shall comply with Section 402.2.1.1. [ASHRAE 62.1:6.4.1.3]

402.2.1.4 Ceiling Height. The ceiling height, H , to be used in Section 402.2.1.1 through Section 402.2.1.3 shall be the minimum ceiling height in the space.

Exception: For ceilings that are increasing in height as distance from the openings is increased, the ceiling height shall be determined as the average height of the ceiling within 20 feet (6096 mm) from the operable openings. [ASHRAE 62.1:6.4.1.4]

402.2.2 Location and Size of Openings. Spaces or portions of spaces to be naturally ventilated shall be permanently open to operable wall openings directly to the outdoors. The openable area shall be not less than 4 percent of the net occupiable floor area. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the net free unobstructed area through the opening. Where interior rooms, or portions of rooms, 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 or less than 25 square feet (2.3 m²). [ASHRAE 62.1:6.4.2]

402.2.3 Control and Accessibility. The means to open required operable openings shall be readily accessible to building occupants where the space is occupied. Controls shall be designed to coordinate operation of the natural and mechanical ventilation systems. [ASHRAE 62.1:6.4.3]

402.3 Mechanical Ventilation. [Not permitted for OSHPD 1, 2, 3, 4 & 5] Where natural ventilation is not permitted by this section or the *California Building Standards Code*, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and

exhaust air. Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate wherever the spaces served are occupied. The system shall be designed to maintain minimum outdoor airflow as required by Section 403.0 under any load conditions.

402.4 Outdoor Air Intake Protection. Required outdoor-air intakes shall be covered with a screen having not less than $\frac{1}{4}$ of an inch (6.4 mm) openings, and shall have not more than $\frac{1}{2}$ of an inch (12.7 mm) openings.

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

403.0 Ventilation Rates. [Not permitted for OSHPD 1, 2, 3, 4 & 5 spaces listed in Table 4-A]

403.1 General. The design outdoor air intake flow rate for a ventilation system shall be determined in accordance with Section 403.2 through Section 403.9.4.

403.2 Zone Calculations. Ventilation zone parameters shall be determined in accordance with Section 403.2.1 through Section 403.2.3 for each ventilation zone served by the ventilation system. [ASHRAE 62.1:6.2.2]

403.2.1 Breathing Zone Outdoor Airflow. The outdoor airflow required in the breathing zone (V_{bz}) of the occupiable space or spaces in a ventilation zone shall be not less than the value determined in accordance with Equation 403.2.1.

$$V_{bz} = R_p \cdot P_z + R_a \cdot A_z \quad \text{(Equation 403.2.1)}$$

Where:

A_z = zone floor area, the net occupiable floor area of the ventilation zone, square feet (m²).

P_z = zone population, the number of people in the ventilation zone during typical usage.

R_p = outdoor airflow rate required per person as determined from Table 402.1.

R_a = outdoor airflow rate required per unit area as determined from Table 402.1. [ASHRAE 62.1:6.2.2.1]

403.2.2 Zone Air Distribution Effectiveness. The zone air distribution effectiveness (E_z) shall be not greater than the default value determined in accordance with Table 403.2.2. [ASHRAE 62.1:6.2.2.2]

403.2.3 Zone Outdoor Airflow. The zone outdoor airflow (V_{Oz}) provided to the ventilation zone by the supply air distribution system shall be determined in accordance with Equation 403.2.3. [ASHRAE 62.1:6.2.2.3]

$$V_{Oz} = V_{bz} / E_z \quad \text{(Equation 403.2.3)}$$

dance 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. Ductwork within the building shall be under negative pressure. 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. (Refer to Section 1224.4.1 of the California Building Code).

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, and areas that may collect vehicular exhaust or other noxious fumes. Plumbing vents shall be located in relation to outdoor air intakes per California Plumbing Code. 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 above 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. Outside air intakes located in a below grade areaway shall have the top of the areaway extend a minimum of 10 feet (3048 mm) above grade.

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.

407.3 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).

407.4 Air Circulation.

407.4.1 Design of the ventilation system shall provide air movement that is generally from clean to less clean areas.

407.4.1.1 Air supplied to operating rooms, cesarean operating rooms, cardiac catheterization labs, cystoscopy rooms, delivery rooms, and class 3 imaging shall be delivered at the ceiling of the area served.

In these areas and in morgues and autopsy rooms 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; except in morgues and autopsy rooms where all of the exhaust air is removed through an autopsy table designed for this purpose. At least two exhaust or recirculation air inlets of equal capacity shall be used in all cardiac catheterization labs, cystoscopy rooms, operating rooms, class 3 imaging 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 Sections 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 Sections 414.0 and 415.0.

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

Exceptions:

- (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.
- (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.

407.4.1.7 Recirculating Room Units. For spaces where Table 4-A permits air to be recirculated by room units, the portion of the minimum total air changes per hour required for a space that is greater than the minimum outdoor air changes per hour required component may be provided by recirculating room HVAC units. Such recirculating room HVAC units shall:

- (1) not receive nonfiltered, nonconditioned outdoor air;
- (2) serve only a single space; and
- (3) provide filtration per Section 408.2 and Section 408.3 for airflow passing over any surface that is designed to condense water. This filter shall be located upstream of any such cold surface, so that all of the air passing over the cold surface is filtered.

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 Section 322.0. For non-sensitive 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 Spaces with pressure requirements per Table 4-A shall utilize an automatic modulating damper in the return or exhaust air for each space. The damper will modulate from full open to minimum position in conjunction with the supply air VAV terminal equipment.

407.6 Economizers. Systems with economizers shall include modulating relief and/or return fans to ensure compliance with the pressure requirements of spaces listed in Table 4-A.

408.0 Filters. [OSHPD 1, 1R, 2, 3, 4 & 5]

408.1 General. Filter efficiencies shall be certified by the manufacturer and shall be based on ASHRAE 52.2 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: 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. Humidification shall be in accordance with 320.1.1.

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 non-sensitive areas shall have a filter with minimum efficiency reporting value (MERV) of 6 based on ASHRAE 52.2.

408.2.3 Noncentral air systems serving any areas not listed in Table 4-B shall have a filter with minimum efficiency reporting value (MERV) of 6 based on ASHRAE 52.2.

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 filter with minimum efficiency reporting value (MERV) of 6, based on ASHRAE 52.2. 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 system.

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 treat-

ment 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 filter with minimum efficiency reporting value (MERV) of 6, based on ASHRAE 52.2. 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 recirculating room units shall have a filter with minimum efficiency reporting value (MERV) of 6 based on ASHRAE 52.2.

409.0 Ducts. [OSHPD 1, 1R, 2, 3, 4 & 5]

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 Insulation of Ducts. Cold air ducts shall be insulated wherever necessary or to prevent condensation.

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 Laboratory Ventilating Systems and Hoods. [OSHPD 1, 1R, 2, 3, 4 & 5]

410.1 Laboratory Ventilating Systems. Laboratory ventilating systems shall comply with NFPA 99, as required by Section 1224.4.6.4 of the California Building Code.

410.2 Exhaust Hoods and Safety Cabinets. Hoods and safety cabinets may be used for normal exhaust of a space provided minimum air change rates are maintained. If air change standards in Table 4-A do not provide sufficient air for proper operation of exhaust hoods and safety cabinets (when in use), supplementary makeup air (filtered and preheated) shall be provided around these units to maintain the required airflow direction and exhaust velocity. Makeup systems for hoods shall be arranged to minimize “short circuiting” of air and to avoid reduction in air velocity at the point of contaminant capture.

410.3 Laboratory Fume Hoods. Laboratory fume hoods shall meet the following standards:

410.3.1 General Standard. Average face velocity shall be at least 75 feet per minute (0.38 meters per second). Exhaust system shall be separate from the building exhaust system. Exhaust fan shall be located at the discharge end of the system. Exhaust duct system shall be of noncombustible corrosion-resistant material as required to meet the planned usage of the hood.

410.3.2 Special Standards for Use with Strong Oxidants. Fume hoods and their associated equipment in the air stream intended for use with perchloric acid and other strong oxidants shall be constructed of stainless steel or other material consistent with special exposures. Hoods and equipment shall be provided with a water wash and drain system to permit periodic flushing of duct and hood. When perchloric acid or other strong oxidants are only transferred from one container to another, standard laboratory fume hoods and the associated equipment may be used in lieu of stainless steel construction.

410.3.3 Special Standards for Use with Infectious or Radioactive Materials. Each hood shall have a minimum face velocity of 90 to 110 feet per minute (0.45 to 0.56 meters per second) with suitable pressure-independent air-modulating devices and alarms to alert staff of fan shutdown or loss of airflow. Each hood shall have filters with a 99.97 percent efficiency (based on the DOP test method) in the exhaust stream and be designed and equipped to permit the safe removal, disposal, and replacement of contaminated filters. Filters shall be as close to the hood as practical to minimize duct contamination. Fume hoods intended for use with radioactive isotopes shall be constructed of stainless steel or other material suitable for the particular exposure.

411.0 Kitchen and Dining Areas. [OSHPD 1, 2, 3, 4 & 5]

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 52.2 or a minimum efficiency reporting value (MERV) of 13, based on ASHRAE 52.2.

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 52.2 or a minimum efficiency reporting value (MERV) of 10, based on ASHRAE 52.2.

412.0 Boiler, Mechanical, and Electrical Rooms. [OSHPD 1, 2, 3, 4 & 5]

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. [OSHPD 1, 2, 3, 4 & 5]

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 Isolation Rooms. [OSHPD 1, 2, 3, 4 & 5]

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.

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 52.2. Filter gage shall be installed across the filter. For maintenance of air balance relationship, see Section 407.3.1. 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 52.2 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 an exhaust or return inlets shall not compromise the safety, security and protection of staff, inmates and property.

415.0 Protective Environment Rooms. [OSHPD 1, 2, 3, 4 & 5]

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 & 5]

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 or when the minimum required pressure differential per ASHRAE 170 between the airborne infection isolation room and corridor or between the protective environment room and corridor is not being met during closed door conditions.

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 and Balancing Airborne Infection Isolation Rooms and Protective Environment Rooms. [OSHPD 1, 2, 3, 4 & 5] 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): the National Environmental Balancing Bureau (NEBB); or the Testing, Adjusting and Balancing Bureau (TABB).

418.0 Design Requirements for Ethylene Oxide (ETO) Sterilization Areas. [OSHPD 1, 1R, 2, 3, 4 & 5]

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).

419.0 Neonatal Intensive Care Units. [OSHPD 1]

419.1 Formula Preparation Area. Air shall be supplied over the formulation preparation area by group E, nonaspirating supply diffusers. Air shall be returned or exhausted by registers located not less than 3 inches (76 mm) nor more than 8 inches (203 mm) above the finished floor in the cleanup area.

419.2 Treatment Area/Room. Air shall be supplied over the treatment surface by group E, nonaspirating supply diffusers. Air shall be returned or exhausted by registers located not less than 3 inches (76 mm) nor more than 8 inches (203 mm) above the finished floor; adjacent to the treatment surface.

420.0 Air Distribution Devices. [OSHPD 1, 2, 3, 4 & 5]

All air distribution devices and supply air outlets shall meet the requirements of ASHRAE 170-2013, Section 6.7.2 and Table 6.7.2.

VENTILATION AIR

**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**

FUNCTION OR SPACE	PRESSURE RELATIONSHIP TO ADJACENT AREAS (f) (n)	MINIMUM OUTDOOR ACH	MINIMUM TOTAL ACH	ALL ROOM AIR EXHAUSTED DIRECTLY TO OUTDOORS (j)	AIR RECIRCULATED BY MEANS OF ROOM UNITS (a)	DESIGN RELATIVE HUMIDITY(k), %	DESIGN TEMPERATURE (l), °F/°C
Airborne infection isolation anteroom (u)	(e)	NR	10	Yes	No	NR	NR
Airborne infection isolation room (u)	Negative	2	12	Yes	No	max 60	70-75/21-24
<i>Airborne infection isolation treatment/exam room</i>	<i>Negative</i>	<i>2</i>	<i>12</i>	<i>Yes</i>	<i>No</i>	<i>max 60</i>	<i>70-75/21-24</i>
<i>Angiography room</i>	<i>Positive</i>	<i>3</i>	<i>15</i>	<i>NR</i>	<i>No</i>	<i>max 60</i>	<i>70-75/21-24</i>
Bathing room	Negative	NR	10	Yes	No	NR	70-75/21-24
Bathroom	Negative	NR	10	Yes	No	NR	72-78/22-26
Bedpan room	Negative	NR	10	Yes	No	NR	NR
<i>Blood bank/tissue storage</i>	<i>NR</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>
<i>Blood draw/phlebotomy</i>	<i>NR</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>
Bronchoscopy, sputum collection, and pentamidine administration (n)	Negative	2	12	Yes	No	NR	68-73/20-23
<i>Cardiac catheterization lab</i>	<i>Positive</i>	<i>3</i>	<i>15</i>	<i>NR</i>	<i>No</i>	<i>max 60</i>	<i>70-75/21-24</i>
<i>Class 1 imaging</i>	<i>NR</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>max 60</i>	<i>72-78/22-26</i>
<i>Class 2 imaging (d), (p)</i>	<i>Positive</i>	<i>3</i>	<i>15</i>	<i>NR</i>	<i>No</i>	<i>max 60</i>	<i>70-75/21-24</i>
<i>Class 3 imaging (m), (o)</i>	<i>Positive</i>	<i>4</i>	<i>20</i>	<i>NR</i>	<i>No</i>	<i>20-60</i>	<i>68-75/20-24</i>
Clean linen storage	Positive	NR	2	NR	NR	NR	72-78/22-26
Clean workroom (central medical and surgical supply space)	Positive	2	4	NR	No	max 60	72-78/22-26
Clean workroom or clean holding (support)	Positive	2	4	NR	NR	NR	NR
Critical and intensive care (ac)	NR	2	6	NR	No	30-60	70-75/21-24
<i>CT Scan</i>	<i>NR</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>max 60</i>	<i>70-75/21-24</i>
Darkroom (g)	Negative	2	10	Yes	No	NR	NR
Delivery room (caesarean) (m), (n), (o)	Positive	4	20	NR	No	20-60	68-75/20-24
Dialysis treatment area	NR	2	6	NR	NR	NR	72-78/22-26
Dialyzer reprocessing room	Negative	NR	10	Yes	No	NR	NR
Dietary storage	NR	NR	2	NR	No	NR	72-78/22-26
<i>Electroconvulsive therapy procedure room</i>	<i>Positive</i>	<i>3</i>	<i>15</i>	<i>NR</i>	<i>No</i>	<i>20-60</i>	<i>70-75/21-24</i>
Emergency department exam/treatment room (p)	NR	2	6	NR	NR	max 60	70-75/21-24
Endoscope cleaning	Negative	2	10	Yes	No	NR	NR
ER decontamination	Negative	2	12	Yes	No	NR	NR
ER waiting rooms	Negative	2	12	Yes (q)	NR	max 65	70-75/21-24
Examination room	NR	2	6	NR	NR	max 60	70-75/21-24
<i>Fast track room</i>	<i>NR</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>
<i>Fluoroscopy room</i>	<i>Negative</i>	<i>2</i>	<i>6</i>	<i>Yes</i>	<i>No</i>	<i>NR</i>	<i>70-75/21-24</i>
Food preparation center (i)	NR	2	10	NR	No	NR	72-78/22-26
Gastrointestinal endoscopy procedure room (x)	NR	2	6	NR	No	20-60	68-73/20-23
Hazardous material storage	Negative	2	10	Yes	No	NR	NR
Hydrotherapy	Negative	2	6	NR	NR	NR	72-80/22-27
<i>Infusion room</i>	<i>Positive</i>	<i>2</i>	<i>6</i>	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>

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

FUNCTION OR SPACE	PRESSURE RELATIONSHIP TO ADJACENT AREAS (f) (n)	MINIMUM OUTDOOR ACH	MINIMUM TOTAL ACH	ALL ROOM AIR EXHAUSTED DIRECTLY TO OUTDOORS (j)	AIR RECIRCULATED BY MEANS OF ROOM UNITS (a)	DESIGN RELATIVE HUMIDITY(k), %	DESIGN TEMPERATURE (l), °F/°C
Intermediate care (s)	NR	2	6	NR	NR	max 60	70-75/21-24
<i>Interventional imaging procedure room</i>	<i>Positive</i>	5	15	NR	No	20-60	70-75/21-24
<i>IV Prep. room</i>	<i>Positive</i>	2	6	NR	NR	NR	NR
Janitor's closet, <i>housekeeping</i>	Negative	NR	10	Yes	No	NR	NR
Labor/delivery/recovery (LDR) (s)	NR	2	6	NR	NR	max 60	70-75/21-24
Labor/delivery/recovery/postpartum (LDRP) (s)	NR	2	6	NR	NR	max 60	70-75/21-24
Laboratory, bacteriology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, biochemistry (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, cytology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, general (v)	Negative	2	6	NR	NR	NR	70-75/21-24
Laboratory, glasswashing	Negative	2	10	Yes	NR	NR	NR
Laboratory, histology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, infectious disease and virus	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, media transfer (v)	Positive	2	4	NR	NR	NR	70-75/21-24
Laboratory, microbiology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, nuclear medicine (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, pathology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, serology (v)	Negative	2	6	Yes	NR	NR	70-75/21-24
Laboratory, sterilizing	Negative	2	10	Yes	NR	NR	70-75/21-24
<i>Lactation</i>	<i>NR</i>	2	6	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>
Laser eye room	Positive	3	15	NR	No	20-60	70-75/21-24
Laundry, general	Negative	2	10	Yes	No	NR	NR
Linen and trash chute room	Negative	NR	10	Yes	No	NR	NR
Medical/anesthesia gas storage (r)	Negative	NR	8	Yes	NR	NR	NR
Medication room	NR	2	4	NR	NR	max 60	70-75/21-24
<i>Morgues and autopsy room (n)</i>	Negative	2	12	Yes	No	NR	68-75/20-24
<i>MRI room</i>	<i>NR</i>	2	6	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>
<i>Negative-pressure x-ray room</i>	<i>Negative</i>	2	12	<i>Yes</i>	<i>No</i>	<i>max 60</i>	<i>72-78/22-26</i>
Newborn intensive care	Positive	2	6	NR	No	30-60	72-78/22-26
<i>Newborn intensive care formula room</i>	<i>Positive</i>	2	10	<i>NR</i>	<i>No</i>	<i>NR</i>	<i>70-75/21-24</i>
Newborn/ <i>well baby</i> nursery suite	NR	2	6	NR	No	30-60	72-78/22-26
Nonrefrigerated body-holding room (h)	Negative	NR	10	Yes	No	NR	70-75/21-24
Nourishment area or room	NR	NR	2	NR	NR	NR	NR
<i>Nuclear medicine (Gamma, PET, SPECT)</i>	<i>Negative</i>	2	6	<i>Yes</i>	<i>No</i>	<i>NR</i>	<i>70-75/21-24</i>
Nuclear medicine hot lab	Negative	NR	6	Yes	No	NR	70-75/21-24
Nuclear medicine treatment room	Negative	2	6	Yes	NR	NR	70-75/21-24
<i>Nurse station (aa)</i>	<i>(aa)</i>	<i>(aa)</i>	2	<i>(aa)</i>	<i>(aa)</i>	<i>(aa)</i>	<i>(aa)</i>
<i>Observation</i>	<i>NR</i>	2	6	<i>NR</i>	<i>NR</i>	<i>NR</i>	<i>70-75/21-24</i>

VENTILATION AIR

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

FUNCTION OR SPACE	PRESSURE RELATIONSHIP TO ADJACENT AREAS (f) (n)	MINIMUM OUTDOOR ACH	MINIMUM TOTAL ACH	ALL ROOM AIR EXHAUSTED DIRECTLY TO OUTDOORS (j)	AIR RECIRCULATED BY MEANS OF ROOM UNITS (a)	DESIGN RELATIVE HUMIDITY(k), %	DESIGN TEMPERATURE (l), °F/°C
Occupational therapy	NR	2	6	NR	NR	NR	70-75/21-24
Operating room, <i>hybrid operating room</i> (m), (n), (o)	Positive	4	20	NR	No	20-60	68-75/20-24
Operating/surgical cystoscopic room (m), (n), (o)	Positive	4	20	NR	No	20-60	68-75/20-24
Patient corridor	NR	NR	2	NR	NR	NR	NR
<i>Patient holding preparation</i>	NR	2	6	NR	No	NR	70-75/21-24
Patient room	NR	2	4 (y)	NR	NR	max 60	70-75/21-24
<i>Pediatric play area</i>	NR	2	6	NR	NR	NR	70-75/21-24
Pharmacy (b)	Positive	2	4	NR	NR	NR	NR
<i>Drug room</i>	NR	2	4	NR	NR	NR	NR
<i>HD ante room (b)</i>	Positive	NR	30	NR	NR	<60	≤68/≤20
<i>HD buffer room (b)</i>	Negative	NR	30	Yes	No	<60	≤68/≤20
<i>HD segregated compounding area (ab)</i>	Negative	NR	12	Yes	NR	NR	NR
<i>HD storage (b)</i>	Negative	NR	12	Yes	NR	NR	NR
<i>Non-HD ante room (b)</i>	Positive	NR	30	NR	NR	<60	≤68/≤20
<i>Non-HD buffer room (b)</i>	Positive	NR	30	NR	No	<60	≤68/≤20
<i>Non-HD segregated compounding area (ad)</i>	NR	NR	NR	NR	NR	NR	NR
Physical therapy (nursing facility)	Negative	2	6	NR	NR	NR	70-75/21-24
Physical therapy (diagnostic and treatment)	Negative	2	6	NR	NR	max 65	72-80/22-27
<i>Post-anesthesia care unit</i>	NR	2	6	Yes	No	20-60	70-75/21-24
<i>Pre-screening area</i>	Negative	2	12	Yes (q)	NR	NR	70-75/21-24
Procedure room (o), (d)	Positive	3	15	NR	No	20-60	70-75/21-24
Protective environment anteroom (t)	(e)	NR	10	NR	No	NR	NR
Protective environment room (t)	Positive	2	12	NR	No	max 60	70-75/21-24
Radiology waiting rooms	Negative	2	12	Yes (q), (w)	NR	max 60	70-75/21-24
Recovery room	NR	2	6	NR	No	20-60	70-75/21-24
<i>Recreation/activity room</i>	NR	2	6	NR	NR	NR	70-75/21-24
Resident gathering/activity/dining (nursing facility)	NR	4	4	NR	NR	NR	70-75/21-24
Resident room (nursing facility)	NR	2	2	NR	NR	NR	70-75/21-24
Resident unit corridor (nursing facility)	NR	NR	4	NR	NR	NR	NR
<i>Seclusion room</i>	NR	2	6	NR	NR	NR	70-75/21-24
<i>Semi-restricted corridor</i>	NR	2	4	NR	NR	NR	NR
<i>Shower room</i>	Negative	NR	10	Yes	No	NR	70-75/21-24
Soiled linen sorting and storage	Negative	NR	10	Yes	No	NR	NR
Soiled or decontamination room	Negative	2	6	Yes	No	NR	72-78/22-26
Soiled workroom or soiled holding, <i>utility room</i>	Negative	2	10	Yes	No	NR	NR
<i>Special purpose room (SNF & ICF only)</i>	NR	2	6	Yes	NR	NR	70-75/21-24

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

FUNCTION OR SPACE	PRESSURE RELATIONSHIP TO ADJACENT AREAS (f) (n)	MINIMUM OUTDOOR ACH	MINIMUM TOTAL ACH	ALL ROOM AIR EXHAUSTED DIRECTLY TO OUTDOORS (j)	AIR RECIRCULATED BY MEANS OF ROOM UNITS (a)	DESIGN RELATIVE HUMIDITY(k), %	DESIGN TEMPERATURE (l), °F/°C
Speech therapy/audiology room	NR	2	6	NR	NR	NR	70-75/21-24
Sterile storage	Positive	2	4	NR	NR	max 60	72-78/22-26
Sterilizer equipment room	Negative	NR	10	Yes	No	NR	NR
Substerile service area	NR	2	6	NR	No	NR	NR
Toilet room	Negative	NR	10	Yes	No	NR	NR
Trauma/cardiac room (crisis or shock) (c)	Positive	3	15	NR	No	20-60	70-75/21-24
Treatment room (surgery and critical care) (p)	NR	2	6	NR	NR	20-60	70-75/21-24
Treatment room (diagnostic and treatment) (x)	NR	2	6	NR	NR	max 60	70-75/21-24
Triage	Negative	2	12	Yes (q)	NR	max 60	70-75/21-24
Ultrasound room	NR	2	6	NR	NR	NR	70-75/21-24
Unsterile supply	NR	2	2	NR	NR	NR	NR
Waiting area (nuclear medicine)	Negative	2	12	Yes(q)	No	NR	70-75/21-24
Waiting area primary care clinic	Negative	2	12	Yes(q)	NR	NR	70-75/21-24
Warewashing	Negative	NR	10	Yes	No	NR	NR
Wound intensive care (burn unit)	NR	2	6	NR	No	40-60	70-75/21-24
X-ray (diagnostic and treatment)	NR	2	6	NR	NR	max 60	72-78/22-26
X-ray (surgery/critical care and catheterization)	Positive	3	15	NR	No	max 60	70-75/21-24

Note: NR = No requirement

Notes for Table 4-A:

- Except where indicated by a “No” in this column, recirculating room HVAC units (with heating or cooling coils) are acceptable for providing that portion of the minimum total air changes per hour that is permitted by Section 407.4.1.7. Because of the cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked “No.” Recirculating devices with HEPA filters shall be permitted in existing facilities as interim, supplemental environmental controls to meet requirements for the control of airborne infectious agents. The design of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The design of such systems shall also allow for easy access for scheduled preventative maintenance and cleaning.
- Additional air change, ISO class, continuous pressure monitoring and filtering requirements for compounding areas shall comply with California Board of Pharmacy regulations Title 16 §1735 & §1751, and USP <797> & <800>. Air supplied to the compounding buffer room and ante room must be introduced through 99.97% minimum HEPA filters located in the ceiling. At least 15 air changes per hour (ACPH) shall be provided to nonhazardous drug (non-HD) compounding buffer rooms through the ceiling. The HEPA filtered air from the PEC in the non-HD buffer room, when added to the HVAC-supplied HEPA-filtered air, shall increase the total HEPA-filtered ACPH to at least 30. If the PEC is used to meet the minimum total ACPH requirements, the PEC must not be turned off except for maintenance. All hazardous drug (HD) compounding areas and PECs shall be externally vented. For both hazardous and non-haz-ardous compounding, minimum air changes shall be met under dynamic operating conditions as defined by USP. Returns and exhaust grilles shall be mounted low on the wall unless a visual smoke study demonstrates dilution of particles and sweeping out of particles from the entire room. One return/exhaust should be placed near the refrigerator compressor. Anteroom shall have a minimum pressure differential of +0.02 inches water column in relation to the adjacent, non-compounding spaces. Non-HD buffer room shall have a pressure differential of +0.02 to +0.05 inches water column in relation to the anteroom. HD buffer room shall have a pressure differential of -0.01 to -0.03 inches water column in relation to the anteroom.
- The term *trauma room* as used herein is a first-aid room and/or emergency room used for general initial treatment of accident victims. The operating room within the trauma center that is routinely used for emergency surgery is considered to be an operating room by this standard.
- Pressure relationships need not be maintained when the room is unoccupied.
- See Section 7.2 of ASHRAE 170 and its subsections for pressure-relationship requirements.
- For operating rooms, cardiac catheterization labs, angiography rooms, cystoscopy rooms, delivery rooms, cesarean operating rooms, newborn intensive care, and class 3 imaging 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 Section 322.0 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 in accordance with Section 407.4.1.3.

VENTILATION AIR

- g. All air need not be exhausted if darkroom equipment has a scavenging exhaust duct attached and meets ventilation standards regarding NIOSH, OSHA, and local employee exposure limits.^{2, 3}
- h. A nonrefrigerated body-holding room is applicable only to facilities that do not perform autopsies on-site and use the space for short periods while waiting for the body to be transferred.
- i. Minimum total air changes per hour (ach) shall be that required to provide proper makeup air to kitchen exhaust systems as specified in ANSI/ASHRAE Standard 154.⁴ In some cases, excess exfiltration or infiltration to or from exit corridors compromises the exit corridor restrictions of NFPA 90A,⁵ the pressure requirements of NFPA 96,⁶ or the maximum defined in the table. During operation, a reduction to the number of air changes to any extent required for odor control shall be permitted when the space is not in use. (See FGI [2010] in Informative Appendix B.)
- j. In some areas with potential contamination and/or odor problems, exhaust air shall be discharged directly to the outdoors and not recirculated to other areas. Individual circumstances may require special consideration for air exhausted to the outdoors. To satisfy exhaust needs, constant replacement air from the outdoors is necessary when the system is in operation.
- k. The RH ranges listed are the minimum and/or maximum allowable at any point within the design temperature range required for that space.
- l. Systems shall be capable of maintaining the rooms within the range during normal operation. Lower or higher temperature shall be permitted when patients' comfort and/or medical conditions require those conditions.
- m. National Institute for Occupational Safety and Health (NIOSH) criteria documents regarding occupational exposure to waste anesthetic gases and vapors, and control of occupational exposure to nitrous oxide⁷ indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized. Refer to NFPA 99 for other requirements.⁸
- n. If pressure-monitoring device alarms are installed, allowances shall be made to prevent nuisance alarms. Short-term excursions from required pressure relationships shall be allowed while doors are moving or temporarily open. Simple visual methods such as smoke trail, ball-in-tube, or flutterstrip shall be permitted for verification of airflow direction.
- o. Surgeons or surgical procedures may require room temperatures, ventilation rates, humidity ranges, and/or air distribution methods that exceed the minimum indicated ranges.
- p. Treatment rooms used for bronchoscopy shall be treated as bronchoscopy rooms. Treatment rooms used for procedures with nitrous oxide shall contain provisions for exhausting anesthetic waste gases.
- q. In a recirculating ventilation system, HEPA filters shall be permitted instead of exhausting the air from these spaces to the outdoors provided that the return air passes through the HEPA filters before it is introduced into any other spaces. The entire minimum total air changes per hour of recirculating airflow shall pass through HEPA filters. When these areas are open to larger, nonwaiting spaces, the exhaust air volume shall be calculated based on the seating area of the waiting area. (**Note:** The intent here is to not require the volume calculation to include a very large space [e.g., an atrium] just because a waiting area opens onto it.)
- r. See NFPA 99 for further requirements.⁸
- s. For intermediate care, labor/delivery/recovery rooms, and labor/delivery/recovery/postpartum rooms, four total ach shall be permitted when supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.) are used.
- t. The protective environment airflow design specifications protect the patient from common environmental airborne infectious microbes (i.e., *Aspergillus* spores). *The anteroom shall have negative air pressure in relation to the protective environment room. A door louver, transfer grille, or other acceptable means may 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.* Recirculation HEPA filters shall be permitted to increase the equivalent room air exchanges; however, the outdoor air changes are still required. Constant-volume airflow is required for consistent ventilation for the protected environment. The pressure relationship to adjacent areas shall remain unchanged if the PE room is utilized as a normal patient room. Rooms with reversible airflow provisions for the purpose of switching between protective environment and AII functions shall not be permitted.
- u. The AII room described in this standard shall be used for isolating the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. *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.* Supplemental recirculating devices using HEPA filters shall be permitted in the AII room to increase the equivalent room air exchanges; however, the minimum outdoor air changes of Table 4-A are still required. AII rooms that are retrofitted from standard patient rooms from which it is impractical to exhaust directly outdoors may be recirculated with air from the AII room, provided that air first passes through a HEPA filter. When the AII room is not utilized for airborne infection isolation, the pressure relationship to adjacent areas, when measured with the door closed, shall remain unchanged and the minimum total air change rate shall be 6 ach. Switching controls for reversible airflow provisions shall not be permitted. A door louver, transfer grille, or other acceptable means may be provided to allow for airflow from the anteroom to the airborne infection isolation room.
- v. When required, appropriate hoods and exhaust devices for the removal of noxious gases or chemical vapors shall be provided in accordance with NFPA 99.⁸
- w. The requirement that all room air is exhausted directly to outdoors applies only to radiology waiting rooms programmed to hold patients who are waiting for chest x-rays for diagnosis of respiratory disease.
- x. If the planned space is designated in the organization's operational plan to be utilized for both bronchoscopy and gastrointestinal endoscopy, the design parameters for "bronchoscopy, sputum collection, and pentamidine administration" shall be used.
- y. For single-bed patient rooms using Group D diffusers, a minimum of six total ach shall be provided and calculated based on the volume from finished floor to 6 ft (1.83 m) above the floor.
- z. *This table is based on Table 7.1 in ASHRAE 170, "Ventilation of Healthcare Facilities", and is used with expressed written permission from ASHRAE.*
 - aa. *Nurse station pressure relationship and ventilation requirements shall match the area in which it is located.*
 - ab. *HD segregated compounding area shall have a differential pressure of -0.01 to -0.03 inches water column in relation to adjacent areas and a minimum of 12 air changes per hour.*
 - ac. *Intensive care patient rooms that contain a modular toilet/sink combination unit within the room shall be provided with a minimum of 75 cfm (35.4 Lis) of exhaust directly over the modular toilet/sink combination unit.*
 - ad. *The requirements for the non-HD segregated compounding area shall meet the minimum requirements for the room which it is located.*

**TABLE 4-B
FILTER EFFICIENCIES FOR CENTRAL VENTILATION AND AIR-CONDITIONING SYSTEMS IN GENERAL ACUTE CARE HOSPITALS, ACUTE PSYCHIATRIC HOSPITALS, OUTPATIENT FACILITIES, AND LICENSED CLINICS¹**

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, NICU formula preparation room, NICU treatment area/room	3	30%	90%	99.97%^{3}
Protective environment rooms	3	(8)	(14)	(17)
		30%	90%	99.97% ⁴
Operating room, Operating/surgical cystoscopic room, Cesarean operating room, Class 3 imaging, Hybrid operating room	2	(8)	(16)	—
		30%	95%	—
Angiography; cardiac catheterization labs; interventional imaging procedure rooms; delivery rooms, nurseries; patient care, treatment, cystoscopy, diagnostic, and related areas; airborne infection isolation rooms; areas providing direct patient service or clean supplies such as sterile and clean processes, and patient area corridors	2	(8)	(14)	—
		30%	90%	—
Laboratories	2	(8)	(13)	—
		30%	80%	—
Administrative, med staff support areas, bulk storage, soiled holding areas, food preparation areas, public cafeterias, and laundries	1 ⁶	(13)	—	—
		80%	—	—
Psychiatric hospitals intended for the care and treatment of inpatients who do not require acute medical services	1 ⁶	(13)	—	—
		80%	—	—

¹ Based on ASHRAE 52.2.

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

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 52.2.

⁶ Additional prefilters with a minimum efficiency of MERV 8 may be used to reduce maintenance for filters.

**TABLE 4-C
FILTER EFFICIENCIES FOR CENTRAL VENTILATION AND AIR-CONDITIONING SYSTEMS IN SKILLED NURSING FACILITIES AND INTERMEDIATE CARE FACILITIES AND CORRECTIONAL TREATMENT CENTERS¹**

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%
Administrative, bulk storage, soiled holding, laundries and food prep areas	1 ⁴	(8)	(13)
		80% ²	—
		(13)	—

¹ Based on ASHRAE 52.2.

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.

⁴ Additional prefilters with a minimum efficiency of MERV 8 may be used to reduce maintenance for filters.

VENTILATION AIR

TABLE 402.1
MINIMUM VENTILATION RATES IN BREATHING ZONE^{1, 2}
[ASHRAE 62.1: TABLE 6.2.2.1]

Note: Ventilation air supply requirements for occupancies regulated by the California Energy Commission are found in the California Energy Code.

OCCUPANCY CATEGORY ⁴	PEOPLE OUTDOOR Air Rate R_p (CFM/person)	AREA OUTDOOR Air Rate R_a (CFM/ft ²)	DEFAULT OCCUPANT DENSITY ³ (people/1000 ft ²)	AIR CLASS
CORRECTIONAL FACILITIES				
Booking/waiting	7.5	0.06	50	2
Cell	5	0.12	25	2
Day room	5	0.06	30	1
Guard stations	5	0.06	15	1
EDUCATIONAL FACILITIES				
Art classroom	10	0.18	20	2
Classrooms (ages 5-8)	10	0.12	25	1
Classrooms (age 9 plus)	10	0.12	35	1
Computer lab	10	0.12	25	1
Daycare (through age 4)	10	0.18	25	2
Daycare sickroom	10	0.18	25	3
Lecture classroom ^h	7.5	0.06	65	1
Lecture hall (fixed seats) ^h	7.5	0.06	150	1
Media center ^a	10	0.12	25	1
Multi-use assembly ^h	7.5	0.06	100	1
Music/theater/dance ^h	10	0.06	35	1
Science laboratories	10	0.18	25	2
University/college laboratories	10	0.18	25	2
Wood/metal shop	10	0.18	20	2
FOOD AND BEVERAGE SERVICE				
Bars, cocktail lounges	7.5	0.18	100	2
Cafeteria/fast food dining	7.5	0.18	100	2
Kitchen (cooking)	7.5	0.12	20	2
Restaurant dining rooms	7.5	0.18	70	2
GENERAL				
Break rooms ^h	5	0.06	25	1
Coffee stations ^h	5	0.06	20	1
Conference/meeting ^h	5	0.06	50	1
Corridors ^h	–	0.06	–	1
Occupiable storage rooms for liquids or gels ^b	5	0.12	2	2
HOTELS, MOTELS, RESORTS, DORMITORIES				
Barracks sleeping areas ^h	5	0.06	20	1
Bedroom/living room ^h	5	0.06	10	1
Laundry rooms, central	5	0.12	10	2
Laundry rooms within dwelling units	5	0.12	10	1
Lobbies/pre-function ^h	7.5	0.06	30	1
Multipurpose assembly ^h	5	0.06	120	1
OFFICE BUILDINGS				
Break Rooms	5	0.12	50	1
Main entry lobbies ^h	5	0.06	10	1
Occupiable storage rooms for dry materials	5	0.06	2	1
Office space ^h	5	0.06	5	1
Reception areas ^h	5	0.06	30	1
Telephone/data entry ^h	5	0.06	60	1
MISCELLANEOUS SPACES				
Bank or bank lobbies ^h	7.5	0.06	15	1
Bank vaults/safe deposit ^h	5	0.06	5	2
Computer (not printing) ^h	5	0.06	4	1
Freezer and refrigerated spaces (<50°F) ^c	10	–	–	2
General manufacturing (excludes heavy industrial and processes using chemicals)	10	0.18	7	3
Pharmacy (prep. area)	5	0.18	10	2
Photo studios	5	0.12	10	1

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 6 – DUCT SYSTEMS**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD					BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4									5
Adopt Entire Chapter	X																					
Adopt Entire Chapter as amended (amended sections listed below)			X	X	X			X	X	X	X	X	X									
Adopt only those sections that are listed below																			X			
Chapter/Section																						
601.2.1																			X			
602.1										X	X	X	X	X	X							
602.1, Exception										X	X	X	X	X	X							
602.2.1				X	X																	
603.3.1				X	X																	
603.4.1										X	X	X	X	X	X							
603.4.1.1										X	X	X	X	X	X							
603.9.2				†	†																	
603.9.2.1																			X			
605.1										X	X	X	X	X	X							
605.2										X	X	X	X	X	X							
605.3										X	X	X		X	X							
606.1				X	X																	
606.8			X					X	X													
607.1				X	X																	
607.1.1										X	X	X	X	X	X							
609.1			X					X	X													
609.1.1			X																			
609.2			X																			

*This state agency does not adopt sections identified with the following symbol: †
The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.*

- » **608.11 Wall Register.** Each wall register shall be connected to the air chamber by a register box or boot.
- » **608.12 Distance from Combustible.** A duct complying with Section 602.0 shall extend from the furnace supply outlet not less than 6 inches (152 mm) below combustible framing.
- » **608.13 Vapor Barrier.** The entire ground surface of the under-floor space shall be covered with a vapor barrier having a thickness not less than 4 mils (0.1 mm) and a flame-spread index of not more than 200.
- » **608.14 Prohibited.** Fuel gas lines and plumbing waste cleanouts shall not be located within the space.

» **609.0 Automatic Shutoffs.**

» **609.1 Air-Moving Systems and Smoke Detectors.** Air-moving systems supplying air in excess of 2000 cubic feet per minute (ft³/min) (0.9439 m³/s) to enclosed spaces within buildings shall be equipped with an automatic shutoff. Automatic shutoff shall be accomplished by interrupting the power source of the air-moving equipment upon detection of smoke in the main supply-air duct *downstream of both the fan and filters* served by such equipment.

Exceptions:

- (1) *Where all portions of the building served by air-moving equipment returning air in excess of 2,000 cubic feet per minute (ft³/min) (0.9439 m³/s) are protected by a total coverage smoke-detection system in accordance with NFPA 72 and the California Fire Code, interconnection to such system shall be permitted to be used to accomplish the required return-air system shutoff.*
- (2) Automatic shutoff is not required where occupied rooms served by the air-handling equipment have direct exit to the exterior, and the travel distance does not exceed 100 feet (30 480 mm).
- (3) Automatic shutoff is not required for Group R, Division 3 and Group U Occupancies.
- (4) Automatic shutoff is not required for approved smoke-control systems or where analysis demonstrates shutoff would create a greater hazard, such as shall be permitted to be encountered in air-moving equipment supplying specialized portions of Group H Occupancies. Such equipment shall be required to have smoke detection with remote indication and manual shutoff capability at an approved location.
- (5) Smoke detectors that are factory installed in listed air-moving equipment shall be permitted to be used in lieu of smoke detectors installed in the main supply-air duct served by such equipment.

609.1.1 Duct Smoke Detectors. *Duct smoke detectors shall comply with UL 268A, shall be labeled by an approved agency, approved and listed by California State Fire Marshal, and shall be installed in accordance with the manufacturer's installation instructions. Such devices shall be compatible with the operating velocities, pressures, temperatures, and humidity's of the system. Where*

fire-detection or alarm systems are provided for the building, the smoke detectors shall be supervised by such systems in an approved manner and installed in accordance with NFPA 72 and the California Building and Fire Codes.

High-rise buildings having occupied floors located more than 75 feet (22 860 mm) above the lowest level of building access shall be provided with duct smoke detection in accordance with Section 609.1 and the California Fire Code, Section 907.2.13.1.

609.2 Air-Moving Systems and Smoke Detectors in Group I-2 occupancies. *In Group I-2 occupancies, air-moving systems returning air in excess of 2,000 cubic feet per minute (ft³/min) (0.9439 m³/s) from enclosed spaces within buildings shall be equipped with an automatic shutoff. Automatic shutoff shall be accomplished by interrupting the power source of the air-moving equipment upon detection of smoke in the return air duct or plenum upstream of any filters, exhaust air connections, outside air connections, or decontamination equipment and appliances.*

Group I-2 occupancies having occupied floors located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access shall be provided with duct smoke detection in accordance with this section and the California Fire Code, Section 907.2.13.1.

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 11 – REFRIGERATION**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD					BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4									5
Adopt Entire Chapter	X			X	X											X						
Adopt Entire Chapter as amended (amended sections listed below)			X					X	X	X	X	X	X	X								
Adopt only those sections that are listed below																						
Chapter/Section																						
1103.1.1			X																			
<i>Table 1103.1.1</i>			X																			
Table 1104.1			X																			
1104.2			X																			
1104.3, <i>Exception</i>										X				X								
1104.5			X																			
<i>1104.6 & subsections</i>			X																			
1104.7			X																			
1104.8.4			X																			
<i>1104.9 & subsections</i>			X																			
1105.12.1			X																			
1106.2.3			X																			
1106.2.5			X																			
1106.2.9.1			X																			
1106.4			X																			
<i>1106.11 & subsections</i>			X																			
<i>Table 1106.11.10.2</i>			X																			
<i>Table 1106.11.11.2</i>			X																			
<i>Figure 1106.11.11.4(1)</i>			X																			
<i>Figure 1106.11.11.4(2)</i>			X																			
Table 1104.1											X	X	X	X	X	X						
1108.4			X					X	X													
1112.11.1			X																			
1115.5			X																			

*This state agency does not adopt sections identified with the following symbol: †
The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.*

CHAPTER 11

REFRIGERATION

1101.0 General.

1101.1 Applicability. Part I governs the design, installation, and construction of refrigeration systems, equipment, refrigerant piping, pressure vessels, safety devices, replacement of parts, alterations, and substitution of different refrigerants. Part II governs the installation and construction of cooling towers.

1101.2 Equipment. Equipment for refrigerant recovery, recycling, or both shall comply with UL 1963.

Part I – Refrigeration Systems.

1102.0 Refrigeration Systems.

1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and ASHRAE 15.

1102.2 Ammonia Refrigeration Systems. Refrigeration systems using ammonia as the refrigerant shall comply with IIAR 2, IIAR 3, IIAR 4, and IIAR 5 and shall not be required to comply with this chapter.

1102.3 Refrigerants. The refrigerant used shall be of a type listed in Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.

Exception: Lithium bromide absorption systems using water as the refrigerant.

1103.0 Classification.

1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.

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

**TABLE 1103.1.1
REFRIGERANT SAFETY GROUP CLASSIFICATIONS**

<i>Higher Flammability</i>	A3	B3
<i>Flammable</i>	A2	B2
<i>Lower Flammability</i>	A2L	B2L
<i>No Flame Propagation</i>	A1	B1
	<i>Lower Toxicity</i>	<i>Higher Toxicity</i>

1103.2 Classification of Refrigeration Systems.

Refrigeration systems shall be classified according to the degree of probability that a leakage of refrigerant will enter an occupancy-classified area in accordance with Section 1103.2.1 and Section 1103.2.2. [ASHRAE 15:5.2]

1103.2.1 High-Probability System. Systems in which the basic design, or the location of components, is such that a leakage of refrigerant from a failed connection, seal, or component will enter the occupied space shall be classified as high-probability systems. A high-probability system shall be a direct system or an indirect open spray system in which the refrigerant is capable of producing pressure that is more than the secondary coolant. [ASHRAE 15:5.2.1]

1103.2.2 Low-Probability System. Systems in which the basic design, or the location of the components, is such that a leakage of refrigerant from a failed connection, seal, or component is not capable of entering the occupied space shall be classified as low-probability systems. A low-probability system shall be an indirect closed system, double indirect system, or an indirect open spray system. In a low-probability indirect open spray system, the secondary coolant pressure remains more than the refrigerant pressure in operating and standby conditions. [ASHRAE 15:5.2.2]

1103.3 Higher Flammability Refrigerants. Group A3 and B3 refrigerants shall not be used except where approved by the Authority Having Jurisdiction.

Exceptions:

- (1) Laboratories with more than 100 square feet (9.29 m²) of space per person.
- (2) Industrial occupancies.
- (3) Listed self-contained systems containing not more than 0.331 pounds (0.150 kg) of Group A3 refrigerant, provided that the equipment is installed in accordance with the listing and the manufacturer’s installation instructions. [ASHRAE 15:7.5.3]

1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.1 System Selection. Refrigeration systems shall be limited in application in accordance with Table 1104.1, and the requirements of Section 1104.0.

1104.2 Refrigerant Concentration Limit (RCL). The concentration of refrigerant in a complete discharge of an independent circuit of high-probability systems shall not exceed the amounts shown in Table 1102.3, except as provided in Section 1104.3, Section 1104.4 and Section 1104.6. The volume of occupied space shall be determined in accordance with Section 1104.2.1 through Section 1104.2.3.

Exceptions:

- (1) Listed equipment in locations other than public corridors and lobbies containing not more than 6.6 pounds (2.99 kg) of refrigerant, regardless of the refrigerant safety classification, provided the equipment is installed in accordance with the listing and with the manufacturer's installation instructions.
- (2) Listed equipment for use in laboratories with more than 100 square feet (9.29 m²) of space per person, regardless of the refrigerant safety classification, provided that the equipment is installed in accordance with the listing and the manufacturer's installation instructions. {ASHRAE 15:7.2}

1104.2.1 Volume Calculations. The volume used to convert from refrigerant concentration limits to refrigerating system quantity limits for refrigerants in Section 1104.2 shall be based on the volume of space to which refrigerant disperses in the event of a refrigerant leak. [ASHRAE 15:7.3]

1104.2.2 Nonconnecting Spaces. Where a refrigerating system or part thereof is located in one or more enclosed occupied spaces that do not connect through permanent openings or HVAC ducts, the volume of the smallest occupied space shall be used to determine the refrigerant quantity limit in the system. Where different stories and floor levels connect through an open atrium or mezzanine arrangement, the volume to be used in calculating the refrigerant quantity limit shall be determined by multiplying the floor area of the lowest space by 8.2 feet (2499 mm). [ASHRAE 15:7.3.1]

1104.2.3 Ventilated Spaces. Where a refrigerating system or a part thereof is located within an air handler, in an air distribution duct system, or in an occupied space served by a mechanical ventilation system, the entire air distribution system shall be analyzed to determine the worst-case distribution of leaked refrigerant. The worst case or the smallest volume in which the leaked refrigerant disperses shall be used to determine the refrigerant quantity limit in the system, subject to the criteria in accordance with Section 1104.2.3.1 through Section 1104.2.3.3. [ASHRAE 15:7.3.2]

1104.2.3.1 Closures. Closures in the air distribution system shall be considered. Where one or more spaces of several arranged in parallel are capable of being closed off from the source of the refrigerant leak, their volume(s) shall not be used in the calculation.

Exceptions: The following closure devices are not considered:

- (1) Smoke dampers, fire dampers, and combination smoke/fire dampers that close only in an emergency not associated with a refrigerant leak.
- (2) Dampers, such as variable-air-volume (VAV) boxes, that provide limited closure where airflow is not reduced below 10 percent of its maximum (with the fan running). [ASHRAE 15:7.3.2.1]

1104.2.3.2 Plenums. The space above a suspended ceiling shall not be included in calculating the refrigerating system quantity limits unless such space is part of the air supply or return system. [ASHRAE 15:7.3.2.2]

1104.2.3.3 Supply and Return Ducts. The volume of the supply and return ducts and plenums shall be included when calculating the refrigerating system quantity limits. [ASHRAE 15:7.3.2.3]

1104.3 Institutional Occupancies. The RCL value required in Section 1104.2 shall be reduced by 50 percent for the areas of institutional occupancies. The total of Group A2, B2, A3, and B3 refrigerants shall not exceed 550 pounds (249.5 kg) in the occupied areas and machinery rooms of institutional occupancies.

Exception: The total of all Group A2L refrigerants shall not be limited in machinery rooms of institutional occupancies.

[OSHPD 1 & 4] Exception: For technology equipment centers not attached to a patient care area the amounts shown in Table 1102.3 may be calculated at 100 percent.

1104.4 Industrial Occupancies and Refrigerated Rooms. Section 1104.2 shall not apply in industrial occupancies and refrigerated rooms where in accordance with the following:

- (1) The space(s) containing the machinery is (are) separated from other occupancies by tight construction with tight-fitting doors.
- (2) Access is restricted to authorized personnel.
- (3) Refrigerant detectors are installed with the sensing location and alarm level as required in refrigeration machinery rooms in accordance with Section 1106.2.6.
- (4) Open flames and surfaces exceeding 800°F (427°C) shall not be permitted where a Group A2, B2, A3, or B3 refrigerant, is used.
- (5) Electrical equipment that is in accordance with Class 1, Division 2, of NFPA 70 where the quantity of a Group A2, B2, A3, or B3 refrigerant in an independent circuit is capable of exceeding 25 percent of the lower flammability limit (LFL) upon release to the space based on the volume determined in accordance with Section 1104.2.1 through Section 1104.2.3.
- (6) Refrigerant containing parts in systems exceeding 100 horsepower (74.6 kW) compressor drive power, except evaporators used for refrigeration or dehumidification, condensers used for heating, control and pressure-relief valves for either, low-probability pumps, and connecting piping, are located in a machinery room or outdoors. [ASHRAE 15:7.2.2]

1104.5 Flammable Refrigerants. The total of Group A2, B2, A3, and B3 refrigerants, other than Group A2L and B2L refrigerants shall not exceed 1100 pounds (498.9 kg) without approval by the Authority Having Jurisdiction. Institutional Occupancies shall comply with Section 1104.3. *Machinery rooms required in accordance with Section 1106.0 based on flammability shall be constructed and maintained in accordance with Section 1106.2.1 through Section 1106.2.6 and Section 1106.11 for Group A2L and B2L refrigerants.*

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

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with the releasable charge limitations of the equipment listing and ASHRAE 15. Unoccupied spaces with refrigerant containing equipment, not including continuous piping or tubing, shall comply with the releasable charge limitations of the equipment listing or Section 1104.6.4. {ASHRAE 15:7.6.1-7.6.1.2}

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

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

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

1104.6.2.3 Refrigerant Detection Systems. Refrigerant detection systems shall be in accordance with the listing and ASHRAE 15.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detection system senses a refrigerant exceeding its setpoint, the following actions shall be taken:

- (1) The supply air fan of the equipment shall activate with a minimum airflow rate specified by the manufacturer.
- (2) Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detection system has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.6(b).

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

- (3) Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
- (4) Mitigation action required by the equipment listing shall be initiated {ASHRAE 15:7.6.2.4}

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently

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

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

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

1104.6.6 Refrigerant Sensors. Refrigerant sensors required by Section 1106.2.6 shall meet the following requirements:

- (1) Refrigerant sensors shall be evaluated by the testing laboratory as part of the equipment listing.
- (2) Refrigerant sensors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating.
 - a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant sensors shall be located within the listed equipment.
 - b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant sensor shall be located in the equipment in accordance with the equipment listing. Additional remote refrigerant sensors shall be permitted within the occupied space when included as part of the equipment mitigation system according to manufacturer's instructions. {ASHRAE 15:7.6.5}

1104.7 Applications for Human Comfort and for Non-industrial Occupancies. In nonindustrial occupancies, Group A2, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants used in high-probability systems for human comfort shall be in accordance with Section 1104.6.

1104.8 Refrigerant Type and Purity. Refrigerants shall be of a type specified by the equipment manufacturer. Unless otherwise specified by the equipment manufacturer, refrigerants used in new equipment shall be of purity in accordance with AHRI 700.

1104.8.1 Recovered Refrigerants. Recovered refrigerants shall not be reused except in the system from which they were removed or as provided in Section 1104.8.2 or Section 1104.8.3. When contamination is evident by discoloration, odor, acid test results, or system

history, recovered refrigerants shall be reclaimed in accordance with Section 1104.8.3 before reuse. [ASHRAE 15:7.5.1.4]

1104.8.2 Recycled Refrigerants. Recycled refrigerants shall not be reused except in systems using the same refrigerant and lubricant designation and belonging to the same owner as the systems from which they were removed. Where contamination is evident by discoloration, odor, acid test results, or system history, recycled refrigerants shall be reclaimed in accordance with Section 1104.8.3.

Exception: Drying shall not be required in order to use recycled refrigerants where water is the refrigerant, is used as an absorbent or is a deliberate additive. [ASHRAE 15:7.5.1.5]

1104.8.3 Reclaimed Refrigerants. Used refrigerants shall not be reused in a different owner's equipment unless tested and found to be in accordance with the requirements of AHRI 700. Contaminated refrigerants shall not be used unless reclaimed and is in accordance with AHRI 700. [ASHRAE 15:7.5.1.6]

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

- (1) The addition of a second refrigerant is allowed by the equipment manufacturer and is in accordance with the manufacturer's instructions.
- (2) The resulting mixture does not change the refrigerant safety group. [ASHRAE 15:7.5.1.7]

Exception: Addition of a second refrigerant shall be permitted where specified by the equipment manufacturer to improve oil return at low temperatures. The refrigerant and amount added shall be in accordance with the manufacturer's instructions. [ASHRAE 15:7.5.1.7]

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

1104.9.1 Approval. The change of refrigerant shall be approved by the owner. [ASHRAE 15:5.3.1]

1104.9.2 Procedures. The change of refrigerant shall be in accordance with one of the following:

- (1) Written instructions of the original equipment manufacturer.
- (2) An evaluation of the system by a registered design professional or by an approved nationally recognized testing laboratory that validates safety and suitability of the replacement refrigerant.
- (3) Approval of the Authority Having Jurisdiction. [ASHRAE 15:5.3.2]

1104.9.3 Replacement Refrigerant of Same Classification. Where the replacement refrigerant is classified into the same safety group, requirements that were applicable to the existing system shall continue to apply. [ASHRAE 15:5.3.3]

1104.9.4 Replacement Refrigerant of Different Classification. Where the replacement refrigerant is classified into a different safety group, the system shall comply with the requirements of this chapter for a new installation, and the change of refrigerant shall require Authority Having Jurisdiction approval. [ASHRAE 15:5.3.4]

1105.0 General Requirements.

1105.1 Human Comfort. Cooling systems used for human comfort shall be in accordance with the return-air and outside-air provisions for furnaces in Section 604.1 and Section 904.7. Cooling equipment used for human comfort in residential buildings shall be selected in accordance with ACCA Manual S to satisfy the calculated loads determined in accordance with ACCA Manual J or other approved methods. Refrigerants used for human comfort shall be in accordance with Section 1104.7.

1105.2 Supports and Anchorage. Supports and anchorage for refrigeration equipment and piping shall be designed in accordance with the building code as Occupancy Category H (hazardous facilities). Supports shall be made of noncombustible materials.

Exceptions:

- (1) Equipment containing Group A1 refrigerants shall be permitted to be supported by the same materials permitted for the building type.
- (2) The use of approved vibration isolators specifically designed for the normal, wind, and seismic loads encountered, shall be permitted.

A compressor or portion of a condensing unit supported from the ground shall rest on a concrete or other approved base extending not less than 3 inches (76 mm) above the adjoining ground level.

1105.3 Access. An unobstructed readily accessible opening and passageway not less than 36 inches (914 mm) in width and 80 inches (2032 mm) in height shall be provided and maintained to the compressor, valves required by this chapter, or other portions of the system requiring routine maintenance.

Exceptions:

- (1) Refrigerant evaporators, suspended overhead, shall be permitted to use portable means of access.
- (2) Air filters, brine control or stop valves, fan motors or drives, and remotely de-energized electrical connections shall be permitted to be provided access to an unobstructed space not less than 30 inches (762 mm) in depth, width, and height. Where an access opening is immediately adjacent to these items and the equipment is capable of being serviced, repaired, and replaced from this opening, the dimensions shall be permitted to be reduced to 22 inches (559 mm) by 30 inches (762 mm) provided the largest piece of equipment is removed through the opening.
- (3) Cooling equipment, using Group A1 refrigerants or brine, located in an attic or furred space shall be permitted to be provided access by a minimum opening and passageway thereto of not less than 22 inches (559 mm) by 30 inches (762 mm).

- (4) Cooling or refrigeration equipment, using Group A1 or B1 refrigerants or brine, located on a roof or on an exterior wall of a building, shall be permitted to be provided access as for furnaces in Section 304.3.

1105.4 Illumination and Service Receptacles. In addition to the requirements of Section 301.4, permanent luminaires shall be installed for equipment required by this code to be accessible or readily accessible. Such luminaires shall provide illumination to perform the required tasks for which access is provided. Control of the illumination source shall be provided at the access entrance.

Exceptions:

- (1) Luminaires shall be permitted to be omitted where the fixed lighting of the building will provide the required illumination.
- (2) Equipment located on the roof or on the exterior walls of a building.

1105.5 Ventilation of Rooms Containing Condensing Units. Where not in a refrigerant machinery room, rooms or spaces in which a refrigerant-containing portion of a condensing unit is installed shall be provided with ventilation in accordance with Section 1105.5.1 or Section 1105.5.2. Ventilation for machinery rooms shall comply with Section 1106.0.

1105.5.1 Permanent Gravity Ventilation Openings. Permanent gravity ventilation openings of not less than 2 square feet (0.2 m²) net free area opening shall be terminated directly to the outside of the building or extend to the outside of the building by continuous ducts.

1105.5.2 Mechanical Exhaust System. A mechanical exhaust system shall be designed to provide a complete change of air not less than every 20 minutes in such room or space and shall discharge to the outside of the building.

Exceptions:

- (1) A condensing unit in a room or space where the cubical content exceeds 1000 cubic feet per horsepower (ft³/hp) (37.95 m³/kW) of the unit.
- (2) A condensing unit in a room or space that has permanent gravity ventilation having an area of 2 square feet (0.2 m²) or more to other rooms or openings exceeding 1000 ft³/hp (37.95 m³/kW).

1105.6 Prohibited Locations. Refrigeration systems or portions thereof shall not be located within a required exit enclosure. Refrigeration compressors exceeding 5 horsepower (3.7 kW) rating shall be located not less than 10 feet (3048 mm) from an exit opening in a Group A; Group B; Group E; Group F; Group I; Group R, Division I; or Group S Occupancy, unless separated by a one-hour fire-resistive occupancy separation.

1105.7 Condensate. Condensate from air-cooling coils shall be collected and drained to an approved location. Drain pans and coils shall be arranged to allow thorough drainage and access for cleaning. Where temperatures drop below freezing, heat tracing and insulation of condensate drains shall be installed.

1105.8 Defrost. Where defrost cycles are required for portions of the system, provisions shall be made for collection and disposal of the defrost liquid in a safe and sanitary manner.

1105.9 Overflows. Where condensate or defrost liquids are generated in an attic or furred space, and structural damage will result from overflow, provisions for overflow shall be provided.

1105.10 Condensate, Defrost, and Overflow Disposal. Disposal of condensate, defrost, or overflow discharges shall comply with Section 310.0.

1105.11 Refrigerant Port Protection. Air conditioning refrigerant circuit access ports located outdoors shall be protected from unauthorized access with locking-type tamper-resistant caps or in a manner approved by the Authority Having Jurisdiction.

Exception: Refrigerant ports in secure locations protected by walls or fencing and requiring key access.

1105.12 Storage. Refrigerants and refrigerant oils not charged within the refrigeration system shall be stored in accordance with Section 1105.12.1 and the fire code. Storage of materials in a refrigeration machinery room shall comply with the fire code.

1105.12.1 Storing Refrigerant. The total amount of refrigerant stored in a machinery room in all containers not provided with relief valves and piping in accordance with Section 1113.0 shall not exceed 330 pounds (149.7 kg). Refrigerant shall be stored in approved storage containers. Additional quantities of refrigerant shall be stored in an approved storage facility. [ASHRAE 15:11.5]

1106.0 Refrigeration Machinery Rooms.

1106.1 Where Required. Refrigeration systems shall be provided with a refrigeration machinery room where the conditions as outlined in Section 1106.1.1 through Section 1106.1.4 exist.

Exception: Refrigeration equipment shall be permitted to be located outdoors in accordance with ASHRAE 15.

1106.1.1 Quantity. The quantity of refrigerant in a single, independent refrigerant circuit of a system exceeds the amounts of Table 1102.3.

1106.1.2 Equipment. Direct- and indirect-fired absorption equipment is used.

Exception: Direct and indirect-fired lithium bromide absorption systems using water as the refrigerant.

1106.1.3 A1 System. An A1 system having an aggregate combined compressor horsepower of 100 (74.6 kW) or more is used.

1106.1.4 A1 Refrigerant. The system contains other than a Group A1 refrigerant.

Exceptions:

- (1) Lithium bromide absorption systems using water as the refrigerant.

- (2) Systems containing less than 300 pounds (136.1 kg) of refrigerant R-123 and located in an approved exterior location.

Refrigeration machinery rooms shall house refrigerant-containing portions of the system other than the piping and evaporators permitted by Section 1104.4, discharge piping required of this chapter, and cooling towers regulated by Part II of this chapter, and their essential piping.

1106.2 Refrigeration Machinery Room, General Requirements. Where a refrigeration system is located indoors and a machinery room is required in accordance with Section 1106.1, the machinery room shall be in accordance with Section 1106.2.1 through Section 1106.2.9.1.

1106.2.1 Access. Machinery rooms shall not be prohibited from housing other mechanical equipment unless specifically prohibited elsewhere in this chapter. A machinery room shall be so dimensioned that parts are accessible with space for service, maintenance, and operations. There shall be clear head room of not less than 7.25 feet (2210 mm) below equipment situated over passageways. [ASHRAE 15:8.11.1]

1106.2.2 Openings. Each refrigeration machinery room shall have a tight-fitting door or doors opening outward, self-closing where they open into the building and adequate in number to ensure freedom for persons to escape in an emergency. With the exception of access doors and panels in air ducts and air-handling units in accordance with Section 1106.2.3, there shall be no openings that will permit passage of escaping refrigerant to other parts of the building. [ASHRAE 15:8.11.2]

1106.2.3 Airflow. There shall be no airflow to or from an occupied space through a machinery room unless the air is ducted and sealed in such a manner as to prevent any refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting. [ASHRAE 15:8.11.3]

1106.2.4 Restricted Access. Access to the refrigeration machinery room shall be restricted to authorized personnel. Doors shall be clearly marked or permanent signs shall be posted at each entrance to indicate this restriction. [ASHRAE 15:8.11.4]

1106.2.5 Detectors and Alarms. Each refrigeration machinery room shall contain one or more refrigerant detectors in accordance with Section 1106.2.6, located in areas where refrigerant from a leak will concentrate, that actuate an alarm and mechanical ventilation in accordance with Section 1106.2.7 at a set point not more than the corresponding Occupational Exposure Limit, OEL, in accordance with Table 1102.3, a set point determined in accordance with the OEL as defined in Chapter 2 shall be approved by the Authority Having Jurisdiction. The alarm shall announce visual and audible alarms inside the refrigeration machinery room and outside each entrance to the refrigeration machinery room. The alarms required in this section shall be of the manual reset type with the reset

located inside the refrigeration machinery room. Alarms set at other levels, such as IDLH, and automatic reset alarms shall be permitted in addition to those required in accordance with this section. The meaning of each alarm shall be clearly marked by signage near the annunciator.

Exception: Refrigerant detectors are not required where only systems using R-718 (water) are located in the refrigeration machinery room. *For Group A2L and B2L, refrigerant detectors shall comply with Section 1106.11.*

1106.2.6 Refrigerant Detectors. Refrigerant detectors required in accordance with Section 1106.2.5 or Section 1107.1.7 shall meet all of the following conditions:

- (1) The refrigerant detector shall perform automatic self-testing of sensors. Where a failure is detected, a trouble signal shall be activated.
- (2) The refrigerant detector shall have one or more set points to activate responses in accordance with Section 1106.2.5 or Section 1107.1.7.
- (3) The refrigerant detector as installed, including any sampling tubes, shall activate responses within a time not to exceed 30 seconds after exposure to refrigerant concentration exceeding the set point value specified in Section 1106.2.5 or Section 1107.1.7.

1106.2.7 Mechanical Ventilation. Machinery rooms shall be vented to the outdoors, utilizing mechanical ventilation in accordance with Section 1106.2.8 and Section 1106.2.9.

1106.2.8 Ventilation. Mechanical ventilation referred to in Section 1106.2.7 shall be by one or more power-driven fans capable of exhausting air from the machinery room at not less than the amount shown in accordance with Section 1106.2.9.

To obtain a reduced airflow for normal ventilation, multiple fans or multispeed fans shall be used. Provision shall be made to supply makeup air to replace that being exhausted. Ducts for supply and exhaust to the machinery room shall serve no other area. The makeup air supply locations shall be positioned relative to the exhaust air locations to avoid short-circuiting. Inlets to the exhaust ducts shall be located in an area where refrigerant from a leak will concentrate, in consideration of the location of the replacement supply air paths, refrigerating machines, and the density of the refrigerant relative to air.

Inlets to exhaust ducts shall be within 1 foot (305 mm) of the lowest point of the machinery room for refrigerants that are heavier than air, and shall be within 1 foot (305 mm) of the highest point for refrigerants that are lighter than air. The discharge of the exhaust air shall be to the outdoors in such a manner as not to cause a nuisance or danger.

1106.2.9 Emergency Ventilation-Required Airflow. An emergency ventilation system shall be required to exhaust an accumulation of refrigerant due to leaks or a rupture of the system. The emergency ventilation required shall be capable of removing air from the machinery room in not less than the airflow quantity in Section 1106.2.9.1. Where multiple refrigerants are present, then the highest airflow quantity shall apply.

1106.2.9.1 Ventilation - A1, A2, A3, B1, B2 and B3 Refrigerants. The emergency ventilation for A1, A2, A3, B1, B2 and B3 refrigerants shall have the capacity to provide mechanical exhaust at a rate as determined in accordance with Equation 1106.2.9.1.

$$Q = 100 \sqrt{G} \quad (\text{Equation 1106.2.9.1})$$

Where:

Q = Air flow rate, cubic feet per minute.

G = Refrigerant mass in largest system, pounds.

For SI units: 1 cubic foot per minute = 0.00047 m³/s, 1 pound = 0.453 kg

1106.3 Normal Operation. A part of the refrigeration machinery room mechanical ventilation shall be in accordance with the following:

- (1) Operated, where occupied, to supply not less than 0.5 CFM/ft² (2.54 L/s/m²) of machinery room area or 20 cubic feet per minute (9.44 L/s) per person.
- (2) Operable, where occupied at a volume required to not exceed the higher of a temperature rise of 18°F (10°C) above inlet air temperature or a maximum temperature of 122°F (50°C).

1106.4 Natural Ventilation. When a refrigerating system is located outdoors more than 20 feet (6096 mm) from building openings and is enclosed by a penthouse, lean-to, or other open structure, natural or mechanical ventilation shall be provided. The requirements for such natural ventilation shall be in accordance with the following:

- (1) The free-aperture cross section for the ventilation of a machinery room shall be not less than as determined in accordance with Equation 1106.4.

$$F = \sqrt{G} \quad (\text{Equation 1106.4})$$

Where:

F = The free opening area, square feet.

G = The mass of refrigerant in the largest system, any part of which is located in the machinery room, pounds.

For SI units: 1 cubic foot per minute = 0.00047 m³/s, 1 pound = 0.453 kg

- (2) Locations of the gravity ventilation openings shall be based on the relative density of the refrigerant to air. [ASHRAE 15:8.14]

1106.5 Combustion Air. No open flames that use combustion air from the machinery room shall be installed where refrigerant is used. Combustion equipment shall not be installed in the same machinery room with refrigerant-containing equipment except under one of the following conditions:

- (1) Combustion air shall be ducted from outside the machinery room and sealed in such a manner as to prevent refrigerant leakage from entering the combustion chamber.
- (2) A refrigerant detector, that is in accordance with Section 1106.2.5, shall be installed to automatically shut down the combustion process in the event of refrigerant leakage.

Exception: Machinery rooms where carbon dioxide (R-744) or water (R-718) is the refrigerant.

1106.6 Ventilation Intake. Makeup air intakes to replace the exhaust air shall be provided to the refrigeration machinery room directly from outside the building. Intakes shall be located as required by other sections of the code and fitted with backdraft dampers or other approved flow-control means to prevent reverse flow. Distribution of makeup air shall be arranged to provide thorough mixing within the refrigeration machinery room to prevent short circuiting of the makeup air directly to the exhaust.

1106.7 Maximum Temperature. Ventilation or mechanical cooling systems shall be provided to maintain a temperature of not more than 104°F (40°C) in the refrigeration machinery room under design load and weather conditions.

1106.8 Refrigerant Parts in Air Duct. Joints and refrigerant-containing parts of a refrigerating system located in an air duct carrying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (371°C) without leakage into the airstream. [ASHRAE 15:8.8]

1106.9 Dimensions. Refrigeration machinery rooms shall be of such dimensions that system parts are readily accessible with approved space for maintenance and operations. An unobstructed walking space not less than 36 inches (914 mm) in width and 80 inches (2032 mm) in height shall be maintained throughout, allowing free access to not less than two sides of moving machinery and approaching each stop valve. Access to refrigeration machinery rooms shall be restricted to authorized personnel and posted with a permanent sign.

1106.10 Exits. Exits shall comply with the building code for special hazards.

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

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

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

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

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

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

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

1106.11.6.1 Mechanical Ventilation. *The machinery room shall have a mechanical ventilation system in accordance with Section 1106.11.11. The mechanical ventilation system shall:*

- (1) *Run continuously, and failure of the mechanical ventilation system actuates an alarm, or*
- (2) *Be activated by one or more refrigerant detectors, conforming to requirements of Section 1106.11.8. [ASHRAE 15:8.13.6.1]*

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

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

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

1106.11.8 Refrigerant Detectors. *Each refrigerating machinery room in accordance with Section 1106.11 shall contain one or more refrigerant detectors in accordance with Section 1106.11.9. The detector(s) sensing element shall be located in areas where refrigerant from a leak will concentrate, with one or more set points that activate responses in accordance with Section 1106.11.10*

for alarms and Section 1106.11.11 for mechanical ventilation. Multiport-type devices shall be prohibited. [ASHRAE 15:8.13.8]

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

- (1) *A refrigerant detector shall be capable of detecting each of the specific refrigerant designations in the machinery room.*
- (2) *The refrigerant detector shall activate responses within a time not to exceed a limit specified in Section 1106.11.10 and Section 1106.11.11 after exposure to refrigerant concentration exceeding a limit value specified in Section 1106.11.10 and Section 1106.11.11.*
- (3) *The refrigerant detector shall have a set point not greater than the applicable Occupational Exposure Limit (OEL) value in accordance with Table 1102.3. The applicable OEL value shall be the lowest OEL value for any refrigerant designation in the machinery room. For refrigerants that do not have an OEL value in Table 1102.3, use a value determined in accordance with the OEL as defined by ASHRAE 34 where approved by the Authority Having Jurisdiction.*
- (4) *The refrigerant detector shall have a set point not more than the applicable Refrigerant Concentration Limit (RCL) value in accordance with Table 1102.3. The applicable RCL value shall be the lowest RCL value for any refrigerant designation in the machinery room. For refrigerants that do not have a RCL value in Table 1102.3, use a value determined in accordance with the RCL as defined by ASHRAE 34 where approved by the Authority Having Jurisdiction.*
- (5) *The refrigerant detector shall provide a means for automatic self-testing and shall be in accordance with Section 1106.11.10.4. The refrigerant detector shall be tested during installation and annually thereafter in accordance with the fire code, or at an interval not exceeding the manufacturer's installation instructions, whichever is less. Testing shall verify compliance with the alarm set points and response times per Section 1106.11.10 and Section 1106.11.11. [ASHRAE 15:8.13.9]*

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

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

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

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

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

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

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

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

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

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

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

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

STATUS	AIRFLOW
Operated when occupied and operated when activated in accordance with Section 1106.11.9(3) and Table 1106.11.10.2	The greater of the following: (1) 0.5 ft ³ /min per ft ² (2.54 L/s per m ²) of machinery room area, or (2) 20 ft ³ /min (9.44 L/s) per person
Operable when occupied	With or without mechanical cooling of the machinery room, the greater of: (1) The airflow rate required to not exceed a temperature rise of 18°F (10°C) above inlet air temperature or (2) The airflow rate required to not exceed a maximum air temperature of 122°F (50°C) in the machinery room.

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

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

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

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

1107.0 Machinery Room, Special Requirements.

1107.1 General. In cases specified in the rules of Section 1106.1, a refrigeration machinery room shall comply with the special requirements in accordance with Section 1107.1.1 through Section 1107.1.10, in addition to Section 1106.2.

1107.1.1 Flame-Producing Devices. There shall be no flame-producing device or continuously operating hot surface over 800°F (427°C) permanently installed in the room.

1107.1.2 Doors. Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors.

1107.1.3 Walls, Floors, and Ceilings. Walls, floor, and ceiling shall be tight and of noncombustible construction. Walls, floor, and ceiling separating the refrigeration machinery room from other occupied spaces shall be not less than one-hour fire-resistive construction.

1107.1.4 Machinery Rooms. The refrigeration machinery room shall have a door that opens directly to the outdoors or through a vestibule equipped with self-closing, tight-fitting doors.

1107.1.5 Exterior Openings. Exterior openings, where present, shall not be under a fire escape or an open stairway.

1107.1.6 Sealing. All pipes piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floor through which they pass.

1107.1.7 Group A2L and B2L Refrigerants. Where refrigerant of Groups A2L or B2L are used, the requirements of Class 1, Division 2, of *the California Electrical Code*, shall not apply to the machinery room provided that the conditions in Section 1107.1.7.1 through Section 1107.1.7.3 are met.

1107.1.7.1 Mechanical Ventilation. The mechanical ventilation system in the machinery room is run continuously in accordance with Section 1106.11.6.1 and failure of the mechanical ventilation system actuates an alarm, or the mechanical ventilation system in the machinery room is activated by one or more refrigerant detectors, in accordance with the requirements of Section 1106.11.11.

1107.1.7.2 Refrigeration Detectors. For the refrigerant detection required in Section 1106.2.5, detection of refrigerant concentration that exceeds 25 percent of the LFL or the upper detection limit of the refrigerant detector, whichever is lower, shall automatically de-energize the following equipment in the machinery room:

- (a) refrigerant compressors
- (b) refrigerant pumps
- (c) normally-closed automatic refrigerant valves

1107.1.7.3 Machinery Rooms. The machinery room shall comply with Section 1106.11.

1107.1.8 Group A2, A3, B2, or B3 Refrigerants. Where any refrigerant of Groups A2, A3, B2, or B3 are used, the machinery room shall comply with Class 1, Division 2, of *the California Electrical Code*.

1107.1.9 Refrigeration Systems. As part of the mechanical ventilation system in accordance with Section 1106.2.8, refrigeration systems that contain more than 110 pounds (50 kg) of any Group A2L, A2, A3, B2L, B2, or B3, refrigerant shall have not less than one exhaust air inlet located adjacent to each system not more than 9 feet (3 m) away.

1107.1.10 Remote Control. Remote control of the mechanical equipment in the refrigeration machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.

1108.0 Refrigeration Machinery Room Equipment and Controls.

1108.1 General. Equipment, piping, ducts, vents, or similar devices that are not essential for the refrigeration process, maintenance of the equipment, or for the illumination, ventilation, or fire protection of the room shall not be placed in or pass through a refrigeration machinery room.

1108.2 Electrical. Electrical equipment and installations shall comply with the electrical code. The refrigeration machinery room shall not be classified as a hazardous location except as provided in Section 1107.1.7 or Section 1107.1.8.

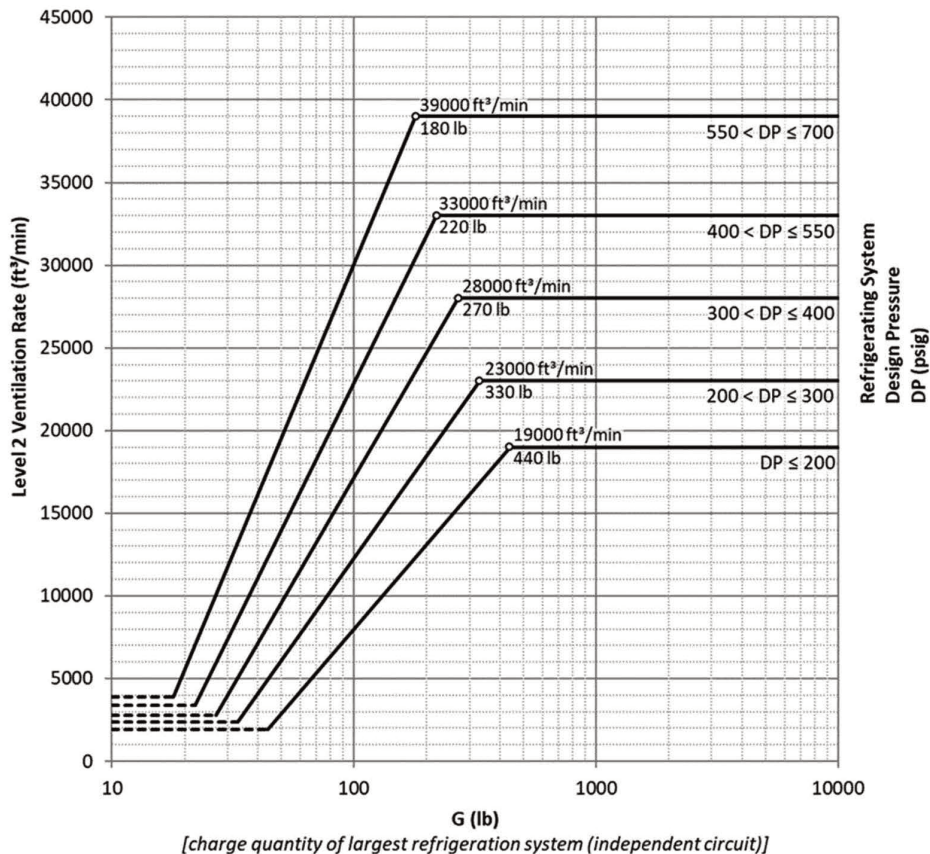
1108.3 Emergency Shut-off. A clearly identified emergency shut-off switch of the break-glass type or with an approved tamper-resistant cover shall be provided immediately adjacent to and outside of the principal refrigeration machinery room entrance. The switch shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally-closed automatic refrigerant valves located in the machinery room. For other than A1 and B1 refrigerants, emergency shutoff shall be automatically activated by refrigerant Alarm 2 in accordance with Section 1106.2.5.

1108.4 Installation, Maintenance, and Testing. Detection and alarm systems in accordance with Section 1106.2.5 shall be installed, maintained, and tested in accordance with the fire code and with the equipment manufacturer's specification.

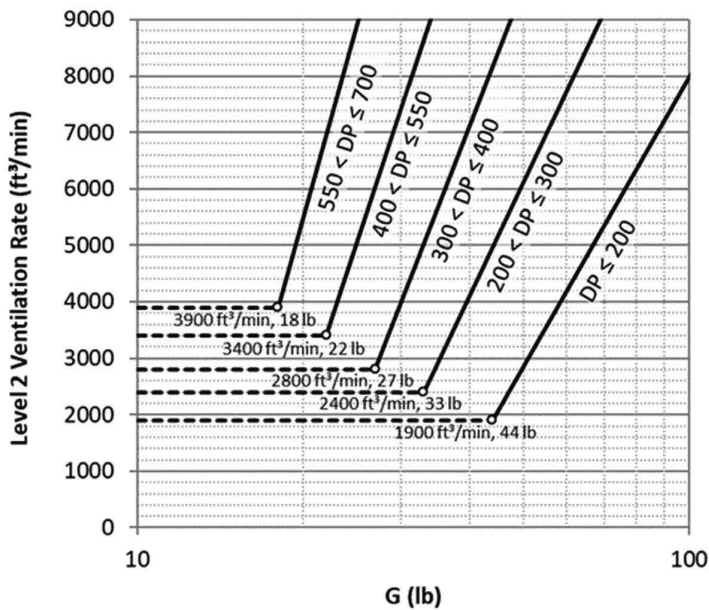
1108.5 Emergency Pressure Control System. Where required by the fire code, an emergency pressure control system shall be installed in accordance with applicable fire code requirements.

1109.0 Refrigeration Piping, Containers, and Valves.

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

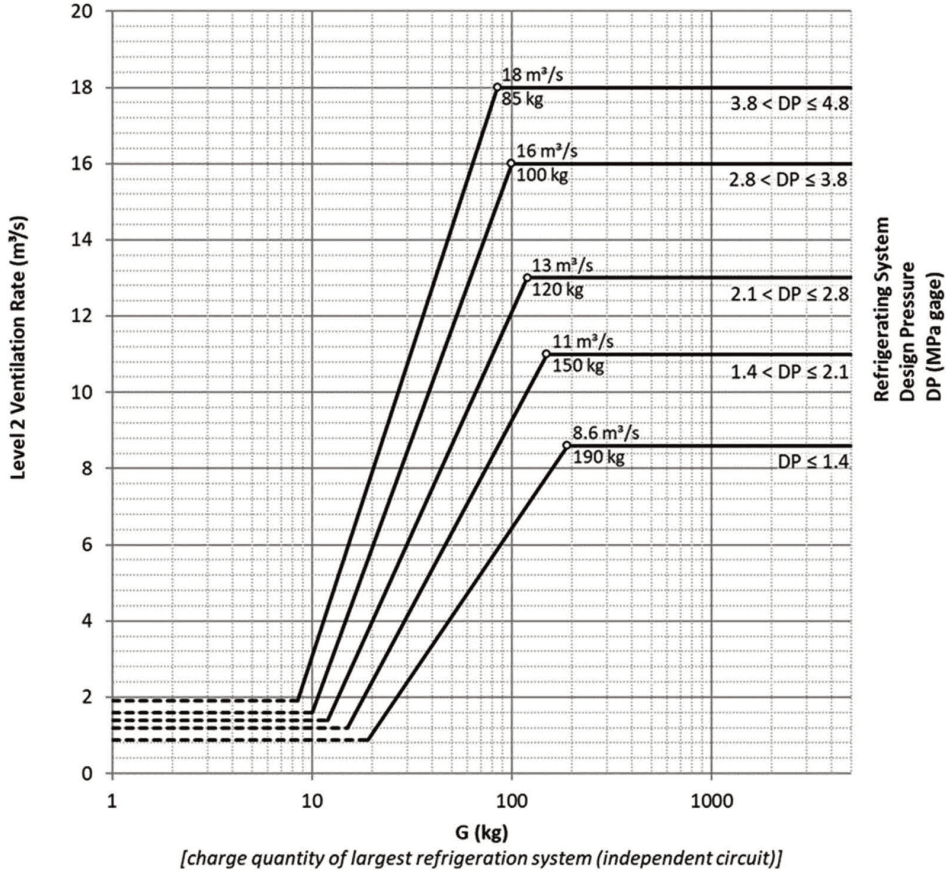


(a)

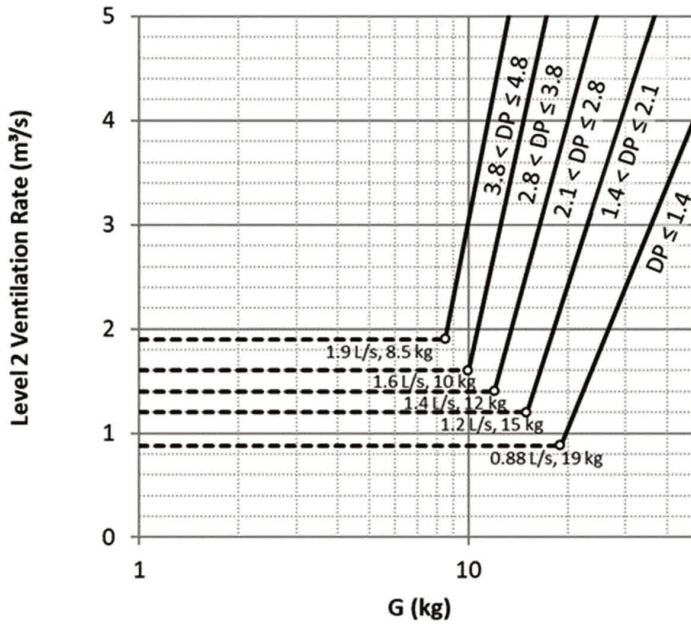


(b)

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



(a)



(b)

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

1109.1.1 Copper and Copper Alloy Pipe. Copper and copper alloy refrigeration piping, valves, fittings, and related parts used in the construction and installation of refrigeration systems shall be approved for the intended use. Refrigeration piping shall comply with ASME B31.5.

1109.1.2 Copper Linesets. Copper linesets shall comply with ASTM B280 or ASTM B1003.

1109.1.3 Iron and Steel. Iron and steel refrigeration piping, valves, fittings, and related parts shall be approved for the intended use. Pipe exceeding 2 inches (50 mm) iron pipe size shall be electric-resistance welded or seamless pipe. Refrigeration piping shall comply with ASME B31.5.

1109.1.4 Prohibited Contact. Aluminum, zinc, magnesium, or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used where in contact with halogenated refrigerants. [ASHRAE 15:9.1.2]

1109.2 Joints. Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press-connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections.

1109.3 Penetration of Piping. Refrigerant piping shall not penetrate floors, ceilings, or roofs.

Exceptions:

- (1) Penetrations connecting the basement and the first floor.
- (2) Penetrations connecting the top floor and a machinery penthouse or roof installation.
- (3) Penetrations connecting adjacent floors served by the refrigeration system.
- (4) Penetrations of a direct system where the refrigerant concentration does not exceed that listed in Table 1102.3 for the smallest occupied space through which the refrigerant piping passes.
- (5) In other than industrial occupancies and where the refrigerant concentration exceeds that listed in Table 1102.3 for the smallest occupied space, penetrations that connect separate pieces of equipment that are in accordance with one of the following:
 - (a) Enclosed by an approved gastight, fire-resistive duct or shaft with openings to those floors served by the refrigerating system.
 - (b) Located on the exterior wall of a building where vented to the outdoors or to the space served by the system and not used as an air shaft, closed court, or similar space. [ASHRAE 15:8.10.3]

1109.4 Location of Refrigeration Piping. Refrigerant piping crossing an open space that affords passageway in a building shall be not less than 7.25 feet (2210 mm) above the floor unless the piping is located against the ceiling of such space and is permitted by the Authority Having Jurisdiction. [ASHRAE 15:8.10.1]

1109.4.1 Protection from Mechanical Damage. Passages shall not be obstructed by refrigerant piping. Refrigerant piping shall not be located in an elevator, dumbwaiter, or other shaft containing a moving object, or in a shaft that has openings to living quarters, or to means of egress. Refrigerant piping shall not be installed in an enclosed public stairway, stair landing, or means of egress. [ASHRAE 15:8.10.2]

1109.5 Underground Piping. Refrigerant piping placed underground shall be protected against corrosion.

1109.5.1 Piping in Concrete Floors. Refrigerant piping installed in concrete floors shall be encased in a pipe duct. Refrigerant piping shall be isolated and supported to prevent damaging vibration, stress, or corrosion. [ASHRAE 15:8.10.4]

1109.6 Support. In addition to the requirements of Section 1105.2, piping and tubing shall be securely fastened to a permanent support within 6 feet (1829 mm) following the first bend in such tubing from the compressor and within 2 feet (610 mm) of each subsequent bend or angle. Piping and tubing shall be supported at points not more than 15 feet (4572 mm) apart.

1109.7 Pipe Enclosure. Refrigerant piping and tubing shall be installed so that it is not subject to damage from an external source. Soft annealed copper tubing shall not exceed 1 $\frac{3}{8}$ inches (35 mm) nominal size. Mechanical joints, other than approved press-connect joints, shall not be made on tubing exceeding $\frac{3}{4}$ of an inch (20 mm) nominal size. Soft annealed copper tubing conveying refrigerant shall be enclosed in iron or steel piping and fittings, or in conduit, molding, or raceway that will protect the tubing against mechanical injury from an exterior source.

Exceptions:

- (1) Tubing entirely within or tubing within 5 feet (1524 mm) of a refrigerant compressor where so located that it is not subject to external injury.
- (2) Copper tubing serving a dwelling unit, where such tubing contains Group A1 refrigerant and is placed in locations not subject to damage from an external source.

1109.8 Visual Inspection. Refrigerant piping and joints erected on the premises shall be exposed to view for visual inspection prior to being covered or enclosed.

Exception: Copper tubing enclosed in iron or steel piping conduit, molding, or raceway, provided there are no fittings or joints concealed therein.

1109.9 Condensation. Piping and fittings that convey brine, refrigerant, or coolants that during normal operation are capable of reaching a surface temperature below the dew point of the surrounding air and that are located in spaces or areas where condensation will cause a hazard to the building occupants or damage to the structure, electrical or other equipment shall be protected to prevent such damage.

REFRIGERATION

1109.10 Identification. Piping shall be in accordance with the reference standard for identification. The type of refrigerant, function and pressure shall be indicated.

1110.0 Valves.

1110.1 More than 6.6 Pounds of Refrigerant. Systems containing more than 6.6 pounds (2.99 kg) of refrigerant shall have stop valves installed at the following locations:

- (1) The suction inlet of a compressor, compressor unit, or condensing unit.
- (2) The discharge of a compressor, compressor unit, or condensing unit.
- (3) The outlet of a liquid receiver.

Exceptions:

- (1) Systems that have a refrigerant pumpout function capable of storing the refrigerant charge, or are equipped with the provisions for pumpout of the refrigerant.
- (2) Self-contained systems. [ASHRAE 15:9.12.4]

1110.2 More than 110 Pounds of Refrigerant. Systems containing more than 110 pounds (49.9 kg) of refrigerant shall have stop valves installed at the following locations:

- (1) The suction inlet of a compressor, compressor unit, or condensing unit.
- (2) The discharge outlet of a compressor, compressor unit, or condensing unit.
- (3) The inlet of a liquid receiver, except for self-contained systems or where the receiver is an integral part of the condenser or condensing unit.
- (4) The outlet of a liquid receiver.
- (5) The inlets and outlets of condensers where more than one condenser is used in parallel in the systems.

Exception: Systems that have a refrigerant pumpout function capable of storing the refrigerant charge, or are equipped with the provisions for pumpout of the refrigerant or self-contained systems. [ASHRAE 15:9.12.5]

1110.3 Support. Stop valves installed in copper refrigerant lines of $\frac{3}{4}$ of an inch (20 mm) or less outside diameter shall be supported independently of the tubing or piping.

1110.4 Access. Stop valves required by Section 1110.0 shall be readily accessible from the refrigeration machinery room floor or a level platform.

1110.5 Identification. Stop valves shall be identified by tagging in accordance with the reference standard for identification. A valve chart shall be mounted under glass at an approved location near the principal entrance to a refrigeration machinery room.

1111.0 Pressure-Limiting Devices.

1111.1 Where Required. Pressure-limiting devices complying with Section 1111.2 through Section 1111.4 shall be provided for compressors on all systems operating above atmospheric pressure.

Exception: Pressure limiting devices are not required for listed factory-sealed systems containing less than 22 pounds (9.9 kg) of Group A1 refrigerant. [ASHRAE 15:9.9.1]

1111.2 Setting. Pressure limiting devices shall be set in accordance with one the following:

- (1) For positive displacement compressors:
 - (a) When systems are protected by a highside pressure relief device, the compressor's pressure limiting device shall be set not more than 90 percent of the operating pressure for the highside pressure relief device.
 - (b) When systems are not protected by a highside pressure relief device, the compressor's pressure limiting device shall be set not more than the system's highside design pressure.
- (2) For nonpositive displacement compressors:
 - (a) When systems are protected by a highside pressure relief device, the compressor's pressure limiting device shall be set not more than 90 percent of the operating pressure for the highside pressure relief device.
 - (b) When systems are protected by a lowside pressure relief device that is only subject to lowside pressure, and is provided with a permanent relief path between the systems' highside and lowside, without intervening valves, the compressor's pressure limiting device shall be set not more than the systems' highside design pressure. [ASHRAE 15:9.9.2]

1111.3 Location. Stop valves shall not be installed between the pressure imposing element and pressure limiting devices serving compressors. [ASHRAE 15:9.9.3]

1111.4 Emergency Stop. Activation of a pressure-limiting device shall stop the action of the pressure-imposing element. [ASHRAE 15:9.9.4]

1112.0 Pressure-Relief Devices.

1112.1 General. Refrigeration systems shall be protected by a pressure-relief device or other approved means to safely relieve pressure due to fire or abnormal conditions. [ASHRAE 15:9.4.1]

1112.2 Positive Displacement Compressor. A positive displacement compressor with a stop valve in the discharge connection shall be equipped with a pressure-relief device that is sized, and with a pressure setting, in accordance with the compressor manufacturer to prevent rupture of the compressor or to prevent the pressure from increasing to more than 10 percent above the maximum allowable working pressure of components located in the discharge line between the compressor and the stop valve or in accordance with Section 1113.5, whichever is larger. The pressure-relief device shall discharge into the low-pressure side of the system or in accordance with Section 1112.11.

Exception: Hermetic refrigerant motor-compressors that are listed and have a displacement not more than 50 cubic feet per minute (1.42 m³/min).

The relief device(s) shall be sized based on compressor flow at the following conditions:

- (1) For compressors in single-stage systems and high-stage compressors of other systems, the flow shall be calculated based on 50°F (10°C) saturated suction temperature at the compressor suction.
- (2) For low-stage or booster compressors in compound systems, the compressors that are capable of running only where discharging to the suction of a high-stage compressor, the flow shall be calculated based on the saturated suction temperature equal to the design operating intermediate temperature.
- (3) For low-stage compressors in cascade systems, the compressors that are located in the lower-temperature stage(s) of cascade systems, the flow shall be calculated based on the suction pressure being equal to the pressure setpoint of the pressure-relieving devices that protect the lowside of the stage against overpressure.

Exceptions: For Section 1112.2(1), Section 1112.2(2), and Section 1112.2(3), the discharge capacity of the relief device shall be permitted to be the minimum regulated flow rate of the compressor where the following conditions are met:

- (1) The compressor is equipped with capacity regulation.
- (2) Capacity regulation actuates to a flow at not less than 90 percent of the pressure-relief device setting.
- (3) A pressure-limiting device is installed and set in accordance with the requirements of Section 1111.0. [ASHRAE 15:9.8]

1112.3 Liquid-Containing Portions of Systems. Liquid-containing portions of systems, including piping, that is isolated from pressure-relief devices required elsewhere, and that develops pressures exceeding their working design pressures due to temperature rise, shall be protected by the installation of pressure-relief devices.

1112.4 Evaporators. Heat exchanger coils located downstream, or upstream within 18 inches (457 mm), of a heating source and capable of being isolated shall be fitted with a pressure-relief device that discharges to another part of the system in accordance with Section 1112.5 through Section 1112.5.2 or outside any enclosed space in accordance with Section 1112.11. The pressure relief device shall be connected at the highest possible location of the heat exchanger or piping between the heat exchanger and its manual isolation valves.

Exceptions:

- (1) Relief valves shall not be required on heat exchanger coils that have a design pressure more than 110 percent of refrigerant saturation pressure when exposed to the maximum heating source temperature.
- (2) A relief valve shall not be required on self-contained or unit systems where the volume of the lowside of the system, which is shut off by valves, is more than the specific volume of the refrigerant at critical conditions of

temperature and pressure, as determined in accordance with Equation 1112.4.

$$V_1 / [W_1 - (V_2 - V_1) / V_{gt}] \quad (\text{Equation 1112.4})$$

Shall be more than V_{gc}

Where:

V_1 = Lowside volume, cubic foot (m³).

V_2 = Total volume of system, cubic foot (m³).

W_1 = Total weight of refrigerant in system, pounds (kg).

V_{gt} = Specific volume of refrigerant vapor at 110°F (43°C), cubic feet per pound (m³/kg).

V_{gc} = Specific volume at critical temperature and pressure, cubic feet per pound (m³/kg). [ASHRAE 15:9.4.4]

1112.5 Hydrostatic Expansion. Pressure rise resulting from hydrostatic expansion due to temperature rise of liquid refrigerant trapped in or between closed valves shall be addressed in accordance with Section 1112.5.1 and Section 1112.5.2. [ASHRAE 15:9.4.3]

1112.5.1 Hydrostatic Expansion During Normal Operation. Where trapping of liquid with subsequent hydrostatic expansion is capable of occurring automatically during normal operation or during standby, shipping, or power failure, engineering controls shall be used that are capable of preventing the pressure from exceeding the design pressure. Acceptable engineering controls include but are not limited to the following:

- (1) Pressure relief device to relieve hydrostatic pressure to another part of the system.
- (2) Reseating pressure relief valve to relieve the hydrostatic pressure to an approved treatment system. [ASHRAE 15:9.4.3.1]

1112.5.2 Hydrostatic Expansion During Maintenance. Where trapping of liquid with subsequent hydrostatic expansion is capable of occurring only during maintenance—i.e., when personnel are performing maintenance tasks—either engineering or administrative controls shall be used to relieve or prevent the hydrostatic overpressure. [ASHRAE 15:9.4.3.2]

1112.6 Actuation. Pressure-relief devices shall be direct-pressure actuated or pilot operated. Pilot-operated pressure-relief valves shall be self-actuated, and the main valve shall open automatically at the set pressure and, where an essential part of the pilot fails, shall discharge its full rated capacity. [ASHRAE 15:9.4.5]

1112.7 Stop Valves Prohibited. Stop valves shall not be located between a pressure-relief device and parts of the system protected thereby. A three-way valve, used in conjunction with the dual relief valve in accordance with Section 1113.6, shall not be considered a stop valve. [ASHRAE 15:9.4.6]

1112.8 Location. Pressure-relief devices shall be connected directly to the pressure vessel or other parts of the system pro-

tected thereby. These devices shall be connected above the liquid refrigerant level and installed so that they are accessible for inspection and repair, and so that they are not capable of being readily rendered inoperative.

Exception: Where fusible plugs are used on the highside, they shall be located above or below the liquid refrigerant level. [ASHRAE 15:9.4.8]

1112.9 Materials. The seats and discs of pressure-relief devices shall be constructed of compatible material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used. Seats and discs shall be limited in distortion, by pressure or other cause, to a set pressure change of not more than 5 percent in a span of five years. [ASHRAE 15:9.4.9]

1112.10 Pressure-Relief Device Settings. Pressure-relief valves shall start to function at a pressure not exceeding the design pressure of the parts of the system protected.

Exception: Relief valves that discharge into other parts of the system shall comply with Section 1112.11.3. [ASHRAE 15:9.5.1]

1112.10.1 Rupture Member Setting. Rupture members used in lieu of, or in series with, a relief valve shall have a nominal rated rupture pressure not exceeding the design pressure of the parts of the system protected. The conditions of application shall comply with ASME BPVC Section VIII. The size of rupture members installed ahead of relief valves shall not be less than the relief-valve inlet. [ASHRAE 15:9.5.2]

1112.11 Discharge from Pressure-Relief Devices. Pressure-relief systems designed for vapor shall comply with Section 1112.11.1 through Section 1112.11.4.1.

1112.11.1 Discharging Location Interior to Building. Pressure-relief devices, including fusible plugs, serving refrigeration systems shall be permitted to discharge to the interior of a building where in accordance with *all of* the following:

- (1) The system contains less than 110 pounds (49.9 kg) of a Group A1 *or* A2L refrigerant.
- (2) The system contains less than 6.6 pounds (2.99 kg) of a Group A2, B1, B2 *or* B2L refrigerant.
- (3) The system does not contain any quantity of a Group A3 or B3 refrigerant.
- (4) The system is to be installed in a machinery room in accordance with Section 1106.0.
- (5) The refrigerant concentration limits in Section 1104.2 are not exceeded. Refrigeration systems that do not comply with the above requirements shall comply with the requirements of Section 1112.11.2 through Section 1112.11.4. [ASHRAE 15:9.7.8.1]

1112.11.2 Discharging Location Exterior to Building. Pressure-relief devices designed to discharge external to the refrigeration system shall be arranged to discharge outside of a building and shall be in accordance with the following:

- (1) The point of vent discharge shall be located not less than 15 feet (4572 mm) above the adjoining ground level.

Exception: Outdoor systems containing Group A1 refrigerant shall be permitted to discharge at any elevation where the point of discharge is located in an access-controlled area accessible to authorized personnel only.

- (2) The point of vent discharge shall be located not less than 20 feet (6096 mm) from windows, building ventilation openings, pedestrian walkways, or building exits.
- (3) For heavier-than-air refrigerants, the point of vent discharge shall be located not less than 20 feet (6096 mm) horizontally from below-grade walkways, entrances, pits or ramps where a release of the entire system charge into such a space would yield a concentration of refrigerant in excess of the RCL. The direct discharge of a relief vent into enclosed outdoor spaces, such as a courtyard with walls on all sides, shall not be permitted where a release of the entire system charge into such a space would yield a concentration of refrigerant in excess of the RCL. The volume for the refrigerant concentration calculation shall be determined using the gross area of the space and a height of 8.2 feet (2499 mm), regardless of the actual height of the enclosed space.
- (4) The termination point of a vent discharge line shall be made in a manner that prevents discharged refrigerant from spraying directly onto personnel that are capable of being in the vicinity.
- (5) The termination point of vent discharge line shall be made in a manner that prevents foreign material or debris from entering the discharge piping.
- (6) Relief vent lines that terminate vertically upward and are subject to moisture entry shall be provided with a drip pocket having a length of not less than 24 inches (610 mm) and having the size of the vent discharge pipe. The drip pocket shall be installed to extend below the first change in vent pipe direction and shall be fitted with a valve or drain plug to permit removal of accumulated moisture. [ASHRAE 15:9.7.8.2]

1112.11.3 Internal Relief. Pressure-relief valves designed to discharge from a higher-pressure vessel into a lower pressure vessel internal to the system shall comply with the following:

- (1) The pressure-relief valve that protects the higher-pressure vessel shall be selected to deliver capacity in accordance with Section 1113.5 without exceeding the maximum allowable working pressure of the higher-pressure vessel accounting for the change in mass flow capacity due to the elevated backpressure.

- (2) The capacity of the pressure-relief valve protecting the part of the system receiving a discharge from a pressure-relief valve protecting a higher-pressure vessel shall be not less than the sum of the capacity required in Section 1113.5 plus the mass flow capacity of the pressure-relief valve discharging into that part of the system.
- (3) The design pressure of the body of the relief valve used on the higher-pressure vessel shall be rated for operation at the design pressure of the higher-pressure vessel in both pressure-containing areas of the valve. [ASHRAE 15:9.7.8.3]

1112.11.4 Discharge Location, Special Requirements. Additional requirements for relief device discharge location and allowances shall apply for specific refrigerants in accordance with Section 1112.11.4.1. [ASHRAE 15:9.7.8.4]

1112.11.4.1 Water (R-718). Where water is the refrigerant, discharge to a floor drain shall be permitted where the following conditions are met:

- (1) The pressure-relief device set pressure shall not exceed 15 psig (103 kPa).
- (2) The floor drain shall be sized to handle the flow rate from a single broken tube in a refrigerant-containing heat exchanger.
- (3) The Authority Having Jurisdiction finds it acceptable that the working fluid, corrosion inhibitor, and other additives used in this type of refrigeration system are permitted to infrequently be discharged to the sewer system, or a catch tank that is sized to handle the expected discharge shall be installed and equipped with a normally closed drain valve and an overflow line to drain. [ASHRAE 15:9.7.8.4.1]

1112.12 Discharge Piping. The piping used for pressure-relief device discharge shall be in accordance with Section 1112.12.1 through Section 1112.12.5. [ASHRAE 15:9.7.9]

1112.12.1 Piping Connection. Piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging of the pipe upon operation of a fusible plug or rupture member. [ASHRAE 15:9.7.9.1]

1112.12.2 Pipe Size. The size of the discharge pipe from the pressure-relief device or fusible plug shall be not less than the outlet size of the pressure-relief device or fusible plug. [ASHRAE 15:9.7.9.2]

1112.12.3 Maximum Length. The maximum length of the discharge piping installed on the outlet of pressure-relief devices and fusible plugs discharging to the atmosphere shall be determined in accordance with Section 1112.12.4 and Section 1112.12.5. See Table 1112.12.3 for the allowable flow capacity of various equivalent lengths of single discharge piping vents for conventional pressure-relief valves. [ASHRAE 15:9.7.9.3]

**TABLE 1112.12.3
ATMOSPHERIC PRESSURE AT NOMINAL
INSTALLATION ELEVATION (Pa)
[ASHRAE 15: TABLE 9.7.9.3.2]**

ELEVATION ABOVE SEA LEVEL, FEET	POUNDS PER SQUARE INCH, ABSOLUTE (P _a)
0	14.7
500	14.4
1000	14.2
1500	13.9
2000	13.7
2500	13.4
3000	13.2
3500	12.9
4000	12.7
4500	12.5
5000	12.2
6000	11.8
7000	11.3
8000	10.9
9000	10.5
10000	10.1

For SI units: 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

1112.12.4 Design Back Pressure. The design back pressure due to flow in the discharge piping at the outlet of pressure-relief devices and fusible plugs, discharging to atmosphere, shall be limited by the allowable equivalent length of piping determined in accordance with Equation 1112.12.4(1).

[Equation 1112.12.4(1)]

$$L = \frac{0.2146 \cdot d^5 (P_0^2 - P_2^2)}{f \cdot Cr^2} - \frac{d \cdot \ln\left(\frac{P_0}{P_2}\right)}{6 \cdot f}$$

Where:

- L* = Equivalent length of discharge piping, feet.
- Cr* = Rated capacity as stamped on the relief device in pounds per minute (lb/min), or in SCFM multiplied by 0.0764, or as calculated in Section 1112.14 for a rupture member or fusible plug, or as adjusted for reduced capacity due to piping in accordance with the manufacturer of the device, or as adjusted for reduced capacity due to piping as estimated by an approved method.
- f* = Moody friction factor in fully turbulent flow.
- d* = Inside diameter of pipe or tube, inches.
- ln* = Natural logarithm.
- P₂* = Absolute pressure at outlet of discharge piping, psia.
- P₀* = Allowed back pressure (absolute) at the outlet of pressure relief device, (psia).

For SI units: 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa, 1 pound per minute = 0.00756 kg/s

Unless the maximum allowable back pressure (P_0) is specified by the relief valve manufacturer, the following maximum allowable back pressure values shall be used for P_0 , where P is the set pressure and P_a is atmospheric pressure at the nominal elevation of the installation (see Table 1112.12.3):

For conventional relief valves: 15 percent of set pressure:

$$P_0 = (0.15 \cdot P) + P_a \quad \text{[Equation 1112.12.4(2)]}$$

For balanced relief valves: 25 percent of set pressure:

$$P_0 = (0.25 \cdot P) + P_a \quad \text{[Equation 1112.12.4(3)]}$$

For rupture disks alone: fusible plugs, and pilot operated relief devices, 50 percent of set pressure:

$$P_0 = (0.50 \cdot P) + P_a \quad \text{[Equation 1112.12.4(4)]}$$

For fusible plugs, P shall be the saturated absolute pressure for the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller. [ASHRAE 15:9.7.9.3.1, 9.7.9.3.2]

1112.12.5 Simultaneous Operation. When outlets of two or more relief devices or fusible plugs, which are expected to operate simultaneously, connect to a common discharge pipe, the common pipe shall be sized large enough to prevent the back pressure at each relief device from exceeding the maximum allowable back pressure in accordance with Section 1112.12.4. [ASHRAE 15:9.7.9.3.3]

1112.13 Rating of Pressure-Relief Device. The rated discharge capacity of a pressure-relief device expressed in pounds of air per minute (kg/s), shall be determined in accordance with ASME BPVC Section VIII. Pipe and fittings between the pressure-relief valve and the parts of the system it protects shall have not less than the area of the pressure-relief valve inlet area. [ASHRAE 15:9.7.6]

1112.14 Rating of Rupture Members and Fusible Plugs. The rated discharge capacity of a rupture member or fusible plug discharging to atmosphere under critical flow conditions, in pounds of air per minute (kg/s), shall be determined in accordance with the following formulas:

$$C = 0.64P_1 d^2 \quad \text{[Equation 1112.14(1)]}$$

$$d = 1.25 \sqrt{C/P_1} \quad \text{[Equation 1112.14(2)]}$$

Where:

C = Rated discharge capacity of air, pounds per minute.

d = Smallest internal diameter of the inlet pipe, retaining flanges, fusible plug, or rupture member; inches.

For rupture members:

[Equation 1112.14(3)]

$$P_1 = (\text{rated pressure in psig} \times 1.1) + 14.7$$

For fusible plugs:

P_1 = Absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, pound-force per square inch atmosphere, psia. [ASHRAE 15:9.7.7]

For SI units: 1 inch = 25.4 mm, 1 pound-force per square inch = 6.8947 kPa, 1 pound per minute = 0.00756 kg/s

1113.0 Overpressure Protection.

1113.1 General. Pressure vessels shall be provided with overpressure protection in accordance with ASME BPVC Section VIII. Pressure vessels containing liquid refrigerant that are capable of being isolated by stop valves from other parts of a refrigerating system shall be provided with overpressure protection. Pressure relief devices or fusible plugs shall be sized in accordance with Section 1113.5. [ASHRAE 15:9.7.1, 9.7.2]

1113.2 Type of Protection. Pressure vessels with an internal gross volume of 3 cubic feet (0.1 m³) or less shall use one or more pressure relief devices or a fusible plug. Pressure vessels of more than 3 cubic feet (0.1 m³) but less than 10 cubic feet (0.28 m³) internal gross volume shall use one or more pressure relief devices. Fusible plugs shall not be used. [ASHRAE 15:9.7.2.1, 9.7.2.2]

1113.3 Discharging into Lowside of System. For pressure-relief valves discharging into the lowside of the system, a single relief valve (not rupture member) of the required relieving capacity shall not be used on vessels of 10 cubic feet (0.28 m³) or more internal gross volume except under the conditions permitted in Section 1112.11.3. [ASHRAE 15:9.7.3]

1113.4 Parallel Pressure-Relief Devices. Two or more pressure-relief devices in parallel to obtain the required capacity shall be considered as one pressure-relief device. The discharge capacity shall be the sum of the capacities required for each pressure vessel being protected.

1113.5 Discharge Capacity. The minimum required discharge capacity of the pressure-relief device or fusible plug for a pressure vessel shall be determined in accordance with Equation 1113.5:

$$C = fDL \quad \text{(Equation 1113.5)}$$

Where:

C = Minimum required discharge capacity of the relief device expressed as mass flow of air, pounds per minute (kg/s).

D = Outside diameter of vessel, feet (m).

L = Length of vessel, feet (m).

f = Factor dependent upon type of refrigerant from Table 1113.5.

Where combustible materials are used within 20 ft (6096 mm) of a pressure vessel, the value of f shall be multiply by 2.5. Equation 1113.5 is based on fire conditions, other heat sources shall be calculated separately. Where one pressure-relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacity required for every pressure vessel. [ASHRAE 15:9.7.5]

TABLE 1113.5
RELIEF DEVICES CAPACITY FACTOR*
[ASHRAE 15:TABLE 9.7.5]

REFRIGERANT	VALUE OF f
Where used on the lowside of a limited-charge cascade system:	
R-23, R-170, R-744, R-1150, R-508A, R-508B	1
R-13, R-13B1, R-503	2
R-14	2.5
Other applications:	
R-718	0.2
R-717	0.5
R-11, R-32, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-764	1
R-12, R-22, R-114, R-124, R-134a, R-401A, R-401B, R-401C, R-405A, R-406A, R-407C, R-407D, R-407E, R-409A, R-409B, R-411A, R-411B, R-411C, R-412A, R-414A, R-414B, R-500, R-1270	1.6
R-143a, R-402B, R-403A, R-407A, R-408A, R-413A	2
R-115, R-402A, R-403B, R-404A, R-407B, R-410A, R-410B, R-502, R-507A, R-509A	2.5

* In accordance with Section 1102.2, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 15 and is not capable of being modified.

1113.6 Three-Way Valve. Pressure vessels of 10 cubic feet (0.28 m³) or more internal gross volume shall use one or more rupture member(s) or dual pressure-relief valves where discharging to the atmosphere. Dual pressure-relief valves shall be installed with a three-way valve to allow testing or repair. Where dual relief valves are used, the valve shall comply with Section 1113.5.

Exception: A single relief valve shall be permitted on pressure vessels of 10 cubic feet (0.28 m³) or more internal gross volume where in accordance with the following conditions:

- (1) The relief valves are located on the lowside of the system.
- (2) The vessel is provided with shutoff valves designed to allow pumpdown of the refrigerant charge of the pressure vessel.
- (3) Other pressure vessels in the system are separately protected in accordance with Section 1113.1. [ASHRAE 15:9.7.2.3]

1114.0 Special Discharge Requirements.

1114.1 General. Systems containing other than Group A1 or B1 refrigerants shall discharge to atmosphere through an approved flaring device.

Exceptions:

- (1) Where the Authority Having Jurisdiction determines upon review of a rational engineering analysis that fire, health, or environmental hazards will not result from the proposed atmospheric release.
- (2) Lithium bromide absorption system using water as the refrigerant.

1114.2 Design Requirements. Flaring devices shall be designed to incinerate the entire discharge. The products of refrigerant incineration shall not pose health or environmental hazards. Incineration shall be automatic upon initiation of discharge, shall be designed to prevent blow-back, and shall not expose structures or materials to the threat of fire. Standby fuel, such as LP-Gas, and standby power shall have the capacity to operate for one and a half times the required time for complete incineration of the charge.

1114.3 Testing. Flaring systems shall be tested to demonstrate their safety and effectiveness. A report from an approved agency shall be submitted detailing the emission products from the system as installed.

1115.0 Labeling and Identification.

1115.1 General. In addition to labels required elsewhere in this chapter, a refrigeration system shall be provided with identification labels in accordance with Section 1115.2 and Section 1115.3.

1115.2 Volume and Type. A condenser, receiver, absorber, accumulator and similar equipment having an internal volume of more than 3 cubic feet (0.1 m³) and containing refrigerant shall be equipped with a permanent label setting forth the type of refrigerant in such vessel.

1115.3 Permanent Sign. In a refrigeration machinery room and for a direct refrigerating system of more than 10 horsepower (7.5 kW), there shall be a permanent sign at an approved location giving the following information:

- (1) Name of contractor installing the equipment.
- (2) Name and number designation of refrigerant in system.
- (3) Pounds of refrigerant in system.

1115.4 Marking of Pressure-Relief Devices. Pressure-relief valves for refrigerant containing components shall be set and sealed by the manufacturer or an assembler as defined in ASME BPVC Section VIII. Each pressure relief valve shall be marked by the manufacturer or assembler with the data required in ASME BPVC Section VIII.

Exception: Relief valves for systems with design pressures of 15 pounds-force per square inch gauge (psig) (103 kPa) or less shall be marked. [ASHRAE 15:9.6.1]

1115.4.1 Rupture Members. Rupture members for refrigerant pressure vessels shall be marked with the data required in accordance with ASME BPVC Section VIII. [ASHRAE 15:9.6.2]

1115.4.2 Fusible Plugs. Fusible plugs shall be marked with the melting temperatures in °F (°C). [ASHRAE 15:9.6.3]

1115.5 Nameplate. Each self-contained system and each separate condensing unit, compressor, or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, design pressures, and refrigerant for which it is designed. The refrigerant shall be designated by the refrigerant number ("R-" number) as shown in Table 1102.3. {ASHRAE 15:9.15}

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

1116.0 Testing of Refrigeration Equipment.

1116.1 Factory Tests. Refrigerant-containing parts of unit systems shall be tested and proved tight by the manufacturer at not less than the design pressure for which they are rated. Pressure vessels shall be tested in accordance with Section 1117.0. [ASHRAE 15:9.14.1]

1116.1.1 Testing Procedure. Tests shall be performed with dry nitrogen or another nonflammable, nonreactive, dried gas. Oxygen, air, or mixtures containing them shall not be used. The means used to build up the test pressure shall have a pressure-limiting device or a pressure-reducing device and a gage on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system's components.

Exceptions:

- (1) Mixtures of dry nitrogen, inert gases, nonflammable refrigerants permitted for factory tests.
- (2) Mixtures of dry nitrogen, inert gases, or a combination of them with flammable refrigerants in concentrations not exceeding the lesser of a refrigerant weight fraction (mass fraction) of 5 percent or 25 percent of the LFL shall be permitted for factory tests.
- (3) Compressed air without added refrigerant shall be permitted for factory tests provided the system is subsequently evacuated to less than 0.039 inch of mercury (0.132 kPa) before charging with refrigerant. The required evacuation level is atmospheric pressure for systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant. [ASHRAE 15:9.14.1.1]

1116.1.2 Applied Pressure. The test pressure applied to the highside of each factory-assembled refrigerating system shall be not less than the design pressure of the highside. The test pressure applied to the lowside of a factory assembled refrigerating system shall be not less than the design pressure of the lowside.

1116.1.3 Design Pressure of 15 psig or Less. Units with a design pressure of 15 psig (103 kPa) or less shall be tested at a pressure not less than 1.33 times the design pressure, and shall be proved leak-tight at not less than the lowside design pressure. [ASHRAE 15:9.14.3]

1116.2 Field Tests. Refrigerant-containing parts of a system that is field-erected shall be tested and proved tight after complete installation and before the operation. The high and low sides of each system shall be tested and proved tight at not less than the lower of the pressure in Table 1116.2 or the setting of the pressure-relief device.

Exceptions:

- (1) Compressors, condensers, evaporators, coded pressure vessels, safety devices, pressure gauges, control mechanisms, and systems that are factory tested.
- (2) Refrigeration systems containing Group R-22, not exceeding 5 tons of refrigeration capacity (18 kW), and field-piped using approved, factory-charged line sets shall be permitted to be proved tight by observing retention of pressure on a set of charging gauges and soaping connections while the system is operating.

**TABLE 1116.2
FIELD LEAK TEST PRESSURES (psig)***

REFRIGERANT NUMBER	HIGHSIDE WATER COOLED	HIGHSIDE AIR COOLED	LOWSIDE
11	15	35	15
12	140	220	140
22	230	360	230
113	15	15	15
114	40	80	40
115	275	340	275
123	15	30	15
134a	150	250	150
152a	130	220	130
500	165	265	165
502	250	385	250
744*	—	—	—

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

* Special design required; test pressures typically exceed 1000 psig (6895 kPa).

1116.3 Test Gases. Tests shall be performed with dry nitrogen or other nonflammable, nonreactive, dried gas. Oxygen, air, or mixtures containing them shall not be used. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gage on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system's components.

Exceptions:

- (1) Mixtures of dry nitrogen, inert gases, or a combination of them with nonflammable refrigerant in concentrations of a refrigerant weight fraction (mass fraction) not exceeding 5 percent shall be permitted for tests.
- (2) Mixtures of dry nitrogen, inert gases, or a combination of them with flammable refrigerants in concentrations not exceeding the lower of a refrigerant weight fraction (mass fraction) of 5 percent or 25 percent of the LFL shall be permitted for tests.
- (3) Compressed air without added refrigerants shall be permitted for tests, provided the system is subsequently

evacuated to less than 1000 microns (0.1333 kPa) before charging with refrigerant. The required evacuation level is atmospheric pressure for systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant.

- (4) Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 of an inch (15.7 mm) outside diameter shall be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at not less than 68°F (20°C). [ASHRAE 15:10.1.2]

1116.4 Declaration. A dated declaration of test shall be provided for systems containing more than 55 pounds (24.9 kg) of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the highside and the lowside of the system. The declaration of test shall be signed by the installer and, where an inspector is present at the tests, the inspector shall also sign the declaration. Where requested, copies of this declaration shall be furnished to the Authority Having Jurisdiction. [ASHRAE 15:10.2]

1116.5 Brine Systems. Brine-containing portions of a system shall be tested at one and a half times the design pressure of the system using brine as the test fluid.

1117.0 Refrigerant-Containing Pressure Vessels.

1117.1 Inside Dimensions 6 Inches or Less. Pressure vessels having inside dimensions of 6 inches (152 mm) or less shall be:

- (1) Listed either individually or as part of an assembly by an approved, nationally recognized testing laboratory, or
- (2) Marked directly on the vessel or on a nameplate attached to the vessel with a “U” or “UM” symbol signifying compliance with ASME BPVC Section VIII, or
- (3) When requested by the Authority Having Jurisdiction, the manufacturer shall provide documentation to confirm that the vessel meets the design, fabrication, and testing requirements of ASME BPVC Section VIII.

Exception: Vessels having an internal or external design pressure of 15 psig (103 kPa) or less.

Pressure vessels having inside dimensions of 6 inches (152 mm) or less shall be protected by either a pressure-relief device or a fusible plug. [ASHRAE 15:9.3.1.1]

1117.1.1 Pressure-Relief Device. Where a pressure-relief device is used to protect a pressure vessel having an inside dimension of 6 inches (152 mm) or less, the ultimate strength of the pressure vessel so protected shall withstand a pressure of not less than 3.0 times the design pressure. [ASHRAE 15:9.3.1.2]

1117.1.2 Fusible Plug. Where a fusible plug is used to protect a pressure vessel having an inside diameter of 6 inches (152 mm) or less, the ultimate strength of the pressure vessel so protected shall withstand a pressure 2.5 times the saturation pressure of the refrigerant used at the temperature stamped on the fusible plug or 2.5 times the critical pressure of the refrigerant used, whichever is less. [ASHRAE 15:9.3.1.3]

1117.2 Inside Dimensions More than 6 Inches. Pressure vessels having an inside diameter exceeding 6 inches (152 mm) and having an internal or external design pressure greater than 15 psig (103 kPa) shall be directly marked, or marked on a nameplate, with a “U” or “UM” symbol signifying compliance with the rules of ASME BPVC Section VIII. [ASHRAE 15:9.3.2]

1117.3 Pressure Vessels for 15 psig or Less. Pressure vessels having an internal or external design pressure of 15 psig (103 kPa) or less shall have an ultimate strength to withstand not less than 3.0 times the design pressure and shall be tested with a pneumatic test pressure of not less than 1.25 times the design pressure or a hydrostatic test pressure of not less than 1.5 times the design pressure. [ASHRAE 15:9.3.3]

1118.0 Maintenance and Operation.

1118.1 General. Refrigeration systems shall be operated and maintained as required by the fire code.

Part II – Cooling Towers.

1119.0 General.

1119.1 Applicability. Cooling towers, evaporative condensers, and fluid coolers shall be readily accessible. Where located on roofs, such equipment having combustible exterior surfaces shall be protected with an approved automatic fire-extinguishing system.

1120.0 Support and Anchorage.

1120.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be supported on noncombustible grillage designed in accordance with the building code. Seismic restraints shall be as required by the building code.

1121.0 Drainage.

1121.1 General. Drains, overflows, and blow-down provisions shall have an indirect connection to an approved disposal location. Discharge of chemical waste shall be as approved by the regulatory authority.

1122.0 Chemical Treatment Systems.

1122.1 General. Chemical treatment systems shall comply with the fire code. Where chemicals used present a contact hazard to personnel, approved emergency eye-wash and shower facilities shall be installed.

1122.2 Automated Control of Cycles of Concentration. Cooling towers, evaporative condensers, and fluid coolers shall include controls that automate system bleed based on conductivity, fraction of metered makeup volume, metered bleed volume, recirculating pump run time, or bleed time.

1123.0 Location.

1123.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be located such that their plumes can-

REFRIGERATION

not enter occupied spaces. Plume discharges shall be not less than 25 feet (7620 mm) away from a ventilation inlet to a building. Location on the property shall be as required for buildings by the building code.

1124.0 Electrical.

1124.1 General. Electrical systems shall be in accordance with the electrical code. Equipment shall be provided with a vibration switch to shut off fans operating with excessive vibration. In climates commonly subject to electrical storms, lightning protection shall be provided on roof-mounted equipment.

1125.0 Refrigerants and Hazardous Fluids.

1125.1 General. Equipment containing refrigerants as a part of a closed-cycle refrigeration system shall comply with Part I of this chapter. Equipment containing other fluids that are flammable, combustible, or hazardous shall be in accordance with this code and the fire code.

1126.0 Drift Eliminators.

1126.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be equipped with drift eliminators that have a drift rate of not more than 0.005 percent of the circulated water flow rate in accordance with the equipment manufacturer's instructions.

TABLE 1102.3
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES⁸
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME ¹ (COMPOSITION FOR BLENDS)	SAFETY GROUP ⁷	OEL ² (ppm)	POUNDS PER 1000 CUBIC FEET OF SPACE
R-11	CCl ₃ F	Trichlorofluoromethane	A1	C1000	0.39
R-12	CCl ₂ F ₂	Dichlorodifluoromethane	A1	1000	5.6
R-12B1	CBrClF ₂	Bromochlorodifluoromethane	—	—	—
R-13	CClF ₃	Chlorotrifluoromethane	A1	1000	—
R-13B1	CBrF ₃	Bromotrifluoromethane	A1	1000	—
R-14	CF ₄	Tetrafluoromethane (carbon tetrafluoride)	A1	1000	25
R-21	CHCl ₂ F	Dichlorofluoromethane	B1	—	—
R-22	CHClF ₂	Chlorodifluoromethane	A1	1000	13
R-23	CHF ₃	Trifluoromethane	A1	1000	7.3
R-30	CH ₂ Cl ₂	Dichloromethane (methylene chloride)	B1	—	—
R-31	CH ₂ ClF	Chlorofluoromethane	—	—	—
R-32	CH ₂ F ₂	Difluoromethane (methylene fluoride)	A2L	1000	4.8
R-40	CH ₃ Cl	Chloromethane (methyl chloride)	B2	—	—
R-41	CH ₃ F	Fluoromethane (methyl fluoride)	—	—	—
R-50	CH ₄	Methane	A3	1000	—
R-113	CCl ₂ FCClF ₂	1, 1, 2-trichloro-1, 2, 2 – trifluoroethane	A1	1000	1.2
R-114	CClF ₂ CClF ₂	1, 2-dichloro-1, 1, 2, 2 tetrafluoroethane	A1	1000	8.7
R-115	CClF ₂ CF ₃	Chloropentafluoroethane	A1	1000	47
R-116	CF ₃ CF ₃	Hexafluoroethane	A1	1000	34
R-123	CHCl ₂ CF ₃	2, 2-dichloro-1, 1, 1, - trifluoroethane	B1	50	3.5
R-124	CHClFCF ₃	2-chloro-1, 1, 1, 2 - tetrafluoroethane	A1	1000	3.5
R-125	CHF ₂ CF ₃	Pentafluoroethane	A1	1000	23
R-134a	CH ₂ FCF ₃	1, 1, 1, 2-tetrafluoroethane	A1	1000	13
R-141b	CH ₃ CCl ₂ F	1, 1-dichloro-1-fluoroethane	—	500	0.78
R-142b	CH ₃ CClF ₂	1-chloro-1, 1-difluoroethane	A2	1000	5.1
R-143a	CH ₃ CF ₃	1, 1, 1-trifluoroethane	A2L	1000	4.5
R-152a	CH ₃ CHF ₂	1, 1-difluoroethane	A2	1000	2.0
R-170	CH ₃ CH ₃	Ethane	A3	1000	0.54
R-E170	CH ₃ OCH ₃	Methoxymethane (Dimethyl ether)	A3	1000	1.0
R-218	CF ₃ CF ₂ CF ₃	Octafluoropropane	A1	1000	43
R-227ea	CF ₃ CHFCF ₃	1, 1, 1, 2, 3, 3, 3-heptafluoropropane	A1	1000	36
R-236fa	CF ₃ CH ₂ CF ₃	1, 1, 1, 3, 3, 3-hexafluoropropane	A1	1000	21
R-245fa	CHF ₂ CH ₂ CF ₃	1, 1, 1, 3, 3-pentafluoropropane	B1	300	12
R-290	CH ₃ CH ₂ CH ₃	Propane	A3	1000	0.56
R-C318	-(CF ₂) ₄ -	Octafluorocyclobutane	A1	1000	41
R-400	zeotrope	R-12/114 (50.0/50.0)	A1	1000	10
R-400	zeotrope	R-12/114 (60.0/40.0)	A1	1000	11
R-401A	zeotrope	R-22/152a/124 (53.0/13.0/34.0)	A1	1000	6.6
R-401B	zeotrope	R-22/152a/124 (61.0/11.0/28.0)	A1	1000	7.2
R-401C	zeotrope	R-22/152a/124 (33.0/15.0/52.0)	A1	1000	5.2
R-402A	zeotrope	R-125/290/22 (60.0/2.0/38.0)	A1	1000	17

REFRIGERATION

TABLE 1102.3 (continued)
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES⁸
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME ¹ (COMPOSITION FOR BLENDS)	SAFETY GROUP ⁷	OEL ² (ppm)	POUNDS PER 1000 CUBIC FEET OF SPACE
R-402B	zeotrope	R-125/290/22 (38.0/2.0/60.0)	A1	1000	15
R-403A	zeotrope	R-290/22/218 (5.0/75.0/20.0)	A2	1000	7.6
R-403B	zeotrope	R-290/22/218 (5.0/56.0/39.0)	A1	1000	18
R-404A	zeotrope	R-125/143a/134a (44.0/52.0/4.0)	A1	1000	31
R-405A	zeotrope	R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)	—	1000	16
R-406A	zeotrope	R-22/600a/142b (55.0/4.0/41.0)	A2	1000	4.7
R-407A	zeotrope	R-32/125/134a (20.0/40.0/40.0)	A1	1000	19
R-407B	zeotrope	R-32/125/134a (10.0/70.0/20.0)	A1	1000	21
R-407C	zeotrope	R-32/125/134a (23.0/25.0/52.0)	A1	1000	18
R-407D	zeotrope	R-32/125/134a (15.0/15.0/70.0)	A1	1000	16
R-407E	zeotrope	R-32/125/134a (25.0/15.0/60.0)	A1	1000	17
R-407F	zeotrope	R-32/125/134a (30.0/30.0/40.0)	A1	1000	20
R-407G	zeotrope	R-32/125/134a (2.5/2.5/95.0)	A1	1000	13
R-407H	zeotrope	R-32/125/134a (32.5/15.0/52.5)	A1	1000	19
R-407I	zeotrope	R-32/125/124a (19.5/8.5/72.0)	A1	1000	16.0
R-408A	zeotrope	R-125/143a/22 (7.0/46.0/47.0)	A1	1000	21
R-409A	zeotrope	R-22/124/142b (60.0/25.0/15.0)	A1	1000	7.1
R-409B	zeotrope	R-22/124/142b (65.0/25.0/10.0)	A1	1000	7.3
R-410A	zeotrope	R-32/125 (50.0/50.0)	A1	1000	26
R-410B	zeotrope	R-32/125 (45.0/55.0)	A1	—	27
R-411A ⁶	zeotrope	R-1270/22/152a (1.5/87.5/11.0)	A2	990	2.9
R-411B ⁶	zeotrope	R-1270/22/152a (3.0/94.0/3.0)	A2	980	2.8
R-412A	zeotrope	R-22/218/142b (70.0/5.0/25.0)	A2	1000	5.1
R-413A	zeotrope	R-218/134a/600a (9.0/88.0/3.0)	A2	1000	5.8
R-414A	zeotrope	R-22/124/600a/142b (51.0/28.5/4.0/16.5)	A1	1000	6.4
R-414B	zeotrope	R-22/124/600a/142b (50.0/39.0/1.5/9.5)	A1	1000	6.0
R-415A	zeotrope	R-22/152a (82.0/18.0)	A2	1000	2.9
R-415B	zeotrope	R-22/152a (25.0/75.0)	A2	1000	2.1
R-416A ⁶	zeotrope	R-134a/124/600 (59.0/39.5/1.5)	A1	1000	3.9
R-417A ⁶	zeotrope	R-125/134a/600 (46.6/50.0/3.4)	A1	1000	3.5
R-417B	zeotrope	R-125/134a/600 (79.0/18.3/2.7)	A1	1000	4.3
R-417C	zeotrope	R-125/134a/600 (19.5/78.8/1.7)	A1	1000	5.4
R-418A	zeotrope	R-290/22/152a (1.5/96.0/2.5)	A2	1000	4.8
R-419A	zeotrope	R-125/134a/E170 (77.0/19.0/4.0)	A2	1000	4.2
R-419B	zeotrope	R-125/134a/E170 (48.5/48.0/3.5)	A2	1000	4.6
R-420A	zeotrope	R-134a/142b (88.0/12.0)	A1	1000	12
R-421A	zeotrope	R-125/134a (58.0/42.0)	A1	1000	17
R-421B	zeotrope	R-125/134a (85.0/15.0)	A1	1000	21
R-422A	zeotrope	R-125/134a/600a (85.1/11.5/3.4)	A1	1000	18
R-422B	zeotrope	R-125/134a/600a (55.0/42.0/3.0)	A1	1000	16
R-422C	zeotrope	R-125/134a/600a (82.0/15.0/3.0)	A1	1000	18
R-422D	zeotrope	R-125/134a/600a (65.1/31.5/3.4)	A1	1000	16
R-422E	zeotrope	R-125/134a/600a (58.0/39.3/2.7)	A1	1000	16
R-423A	zeotrope	R-134a/227ea (52.5/47.5)	A1	1000	19
R-424A ⁶	zeotrope	R-125/134a/600a/600/601a (50.5/47.0/0.9/1.0/0.6)	A1	970	6.2
R-425A	zeotrope	R-32/134a/227ea (18.5/69.5/12.0)	A1	1000	16

TABLE 1102.3 (continued)
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES⁸
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME ¹ (COMPOSITION FOR BLENDS)	SAFETY GROUP ⁷	OEL ² (ppm)	POUNDS PER 1000 CUBIC FEET OF SPACE
R-426A ⁶	zeotrope	R-125/134a/600/601a (5.1/93.0/1.3/0.6)	A1	990	5.2
R427A	zeotrope	R-32/125/143a/134a (15.0/25.0/10.0/50.0)	A1	1000	18
R428A	zeotrope	R-125/143a/290/600a (77.5/20.0/0.6/1.9)	A1	1000	23
R-429A	zeotrope	R-E170/152a/600a (60.0/10.0/30.0)	A3	1000	0.81
R-430A	zeotrope	R-152a/600a (76.0/24.0)	A3	1000	1.3
R-431A	zeotrope	R-290/152a (71.0/29.0)	A3	1000	0.69
R-432A	zeotrope	R-1270/E170 (80.0/20.0)	A3	700	0.13
R-433A	zeotrope	R-1270/290 (30.0/70.0)	A3	880	0.34
R-433B	zeotrope	R-1270/290 (5.0/95.0)	A3	950	0.51
R-433C	zeotrope	R-1270/290 (25.0/75.0)	A3	790	0.41
R-434A	zeotrope	R-125/143a/134a/600a (63.2/18.0/16.0/2.8)	A1	1000	20
R-435A	zeotrope	R-E170/152a (80.0/20.0)	A3	1000	1.1
R-436A	zeotrope	R-290/600a (56.0/44.0)	A3	1000	0.50
R-436B	zeotrope	R-290/600a (52.0/48.0)	A3	1000	0.51
R-437A	zeotrope	R-125/134a/600/601 (19.5/78.5/1.4/0.6)	A1	990	5.0
R-438A	zeotrope	R-32/125/134a/600/601a (8.5/45.0/44.2/1.7/0.6)	A1	990	4.9
R-439A	zeotrope	R-32/125/600a (50.0/47.0/3.0)	A2	990	4.7
R-440A	zeotrope	R-290/134a/152a (0.6/1.6/97.8)	A2	1000	1.9
R-441A	zeotrope	R-170/290/600a/600 (3.1/54.8/6.0/36.1)	A3	1000	0.39
R-442A	zeotrope	R-32/125/134a/152a/227ea (31.0/31.0/30.0/3.0/5.0)	A1	1000	21
R-443A	zeotrope	R-1270/290/600a (55.0/40.0/5.0)	A3	580	0.19
R-444A	zeotrope	R-32/152a/1234ze(E) (12.0/5.0/83.0)	A2L	850	5.1
R-444B	zeotrope	R-32/152a/1234ze(E) (41.5/10.0/48.5)	A2L	890	4.3
R-445A	zeotrope	R-744/134a/1234ze (E) (6.0/9.0/85.0)	A2L	930	4.2
R-446A	zeotrope	R-32/1234ze(E)/600 (68.0/29.0/3.0)	A2L	960	2.5
R-447A	zeotrope	R-32/125/1234ze(E) (68.0/3.5/28.5)	A2L	900	2.6
R-447B	zeotrope	R-32/125/1234ze(E) (68.0/8.0/24.0)	A2L	970	23
R-448A	zeotrope	R-32/125/1234yf/134a/1234ze(E) (26.0/26.0/20.0/21.0/7.0)	A1	890	24
R-449A	zeotrope	R-32 /125 /1234yf /134a (24.3/24.7/25.3/25.7)	A1	830	23
R-449B	zeotrope	R-32/125/1234yf/134a (25.2/24.3/23.2/27.3)	A1	850	23
R-449C	zeotrope	R-32/125/1234yf/134a (20.0/20.0/31.0/29.0)	A1	800	23
R-450A	zeotrope	R-134a/1234ze(E) (42.0/58.0)	A1	880	20
R-451A	zeotrope	R-1234yf/134a (89.8/10.2)	A2L	520	5.3
R-451B	zeotrope	R-1234yf/134a (88.8/11.2)	A2L	530	5.3
R-452A	zeotrope	R-32/125/1234yf (11.0/59.0/30.0)	A1	780	27
R-452B	zeotrope	R-32/125/1234yf (67.0/7.0/26.0)	A2L	870	23
R-452C	zeotrope	R-32/125/1234yf (12.5/61.0/26.5)	A1	800	27
R-453A	zeotrope	R-32/125/134a/227ea/600/601a (20.0/20.0/53.8/5.0/0.6/0.6)	A1	1000	7.8
R-454A	zeotrope	R-32/1234yf (35.0/65.0)	A2L	690	28
R-454B	zeotrope	R-32/1234yf (68.9/31.1)	A2L	850	22
R-454C	zeotrope	R-32/1234yf (21.5/78.5)	A2L	620	29

REFRIGERATION

TABLE 1102.3 (continued)
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES⁸
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME ¹ (COMPOSITION FOR BLENDS)	SAFETY GROUP ⁷	OEL ² (ppm)	POUNDS PER 1000 CUBIC FEET OF SPACE
R-455A	zeotrope	R-744/32/1234yf (3.0/21.5/75.5)	A2L	650	23
R-456A	zeotrope	R-32/134a/1234ze(E) (6.0/45.0/49.0)	A1	900	20
R-457A	zeotrope	R-32/1234yf/152a (18.0/70.0/12.0)	A2L	650	25
R-458A	zeotrope	R-32/125/134a/227ea/236fa (20.5/4.0/61.4/13.5/0.6)	A1	1000	18
R-459A	zeotrope	R-32/1234yf/1234ze(E) (68.0/26.0/6.0)	A2L	870	23
R-459B	zeotrope	R-32/1234yf/1234ze(E) (21.0/69.0/10.0)	A2L	640	30
R-460A	zeotrope	R-32/125/134a/1234ze(E) (12.0/52.0/14.0/22.0)	A1	650	24
R-460B	zeotrope	R-32/125/134a/1234ze(E) (28.0/25.0/20.0/27.0)	A1	950	25
R-460C	zeotrope	R-32/125/134a/1234ze(E) (2.5/2.5/46.0/49.0)	A1	900	20.0
R-461A	zeotrope	R-125/143a/134a/227ea/600a (55.0/5.0/32.0/5.0/3.0)	A1	1000	17
R-462A	zeotrope	R-32/125/143a/134a/600 (9.0/42.0/2.0/44.0/3.0)	A2	1000	3.9
R-463A	zeotrope	R-744/32/125/1234yf/134a (6.0/36.0/30.0/14.0/14.0)	A1	990	19
R-464A	zeotrope	R-32/125/1234ze(E)/227ea (27.0/27.0/40.0/6.0)	A1	930	27.0
R-465A	zeotrope	R-32/290/1234yf (21.0/7.9/71.1)	A2	660	2.5
R-500	azeotrope ³	R-12/152a (73.8/26.2)	A1	1000	7.6
R-501	azeotrope ³	R-22/12 (75.0/25.0) ⁴	A1	1000	13
R-502	azeotrope ³	R-22/115 (48.8/51.2)	A1	1000	21
R-503	azeotrope ³	R-23/13 (40.1/59.9)	—	1000	—
R-504	azeotrope ³	R-32/115 (48.2/51.8)	—	1000	28
R-505	azeotrope ³	R-12/31 (78.0/22.0) ⁴	—	—	—
R-506	azeotrope ³	R-31/114 (55.1/44.9)	—	—	—
R-507A ⁵	azeotrope ³	R-125/143a (50.0/50.0)	A1	1000	32
R-508A ⁵	azeotrope ³	R-23/116 (39.0/61.0)	A1	1000	14
R-508B	azeotrope ³	R-23/116 (46.0/54.0)	A1	1000	13
R-509A ⁵	azeotrope ³	R-22/218 (44.0/56.0)	A1	1000	24
R-510A	azeotrope ³	R-E170/600a (88.0/12.0)	A3	1000	0.87
R-511A	azeotrope ³	R-290/E170 (95.0/5.0)	A3	1000	0.59
R-512A	azeotrope ³	R-134a/152a (5.0/95.0)	A2	1000	1.9
R-513A	azeotrope ³	R-1234yf/134a (56.0/44.0)	A1	650	20
R-513B	azeotrope ³	R-1234yf/134a (58.5/41.5)	A1	640	21
R-514A	azeotrope ³	R-1336mzz(Z)/1130 (E) (74.7/25.3)	B1	320	0.86
R-515A	azeotrope ³	R-1234ze(E)/227ea (88.0/12.0)	A1	810	19
R-516A	azeotrope ³	R-1234yf/134a/152a (77.5/8.5/14.0)	A2L	590	7.0
R-600	CH ₃ CH ₂ CH ₂ CH ₃	Butane	A3	1000	0.15
R-600a	CH(CH ₃) ₂ CH ₃	2-methylpropane (isobutene)	A3	1000	0.59
R-601	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	Pentane	A3	600	0.18

TABLE 1102.3 (continued)
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES⁸
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

REFRIGERANT	CHEMICAL FORMULA	CHEMICAL NAME ¹ (COMPOSITION FOR BLENDS)	SAFETY GROUP ⁷	OEL ² (ppm)	POUNDS PER 1000 CUBIC FEET OF SPACE
R-601a	(CH ₃) ₂ CHCH ₂ CH ₃	2-methylbutane (isopentane)	A3	600	0.18
R-610	CH ₃ CH ₂ OCH ₂ CH ₃	Ethoxyethane (ethyl ether)	—	400	—
R-611	HCOOCH ₃	Methyl formate	B2	100	—
R-620	—	(Reserved for future assignment)	—	—	—
R-630	CH ₃ NH ₂	Methanamine (methyl amine)	—	—	—
R-631	CH ₃ CH ₂ (NH ₂)	Ethanamine (ethyl amine)	—	—	—
R-702	H ₂	Hydrogen	A3	—	—
R-704	He	Helium	A1	—	—
R-717	NH ₃	Ammonia	B2L	25	0.014
R-718	H ₂ O	Water	A1	—	—
R-720	Ne	Neon	A1	—	—
R-728	N ₂	Nitrogen	A1	—	—
R-732	O ₂	Oxygen	—	—	—
R-740	Ar	Argon	A1	—	—
R-744	CO ₂	Carbon dioxide	A1	5000	3.4
R-744A	N ₂ O	Nitrous oxide	—	—	—
R-764	SO ₂	Sulfur dioxide	B1	—	—
R-1130(E)	CHCl=CHCl	Trans-1,2-dichloroethene	B1	200	0.25
R-1132a	CF ₂ =CH ₂	1, 1-difluoroethylene	A2	500	2.0
R-1150	CH ₂ =CH ₂	Ethene (ethylene)	A3	200	—
R-1224yd(Z)	CF ₃ CF=CHCl	(Z)-1-chloro-2,3,3,3-tetrafluoropropene	A1	1000	23
R-1233zd(E)	CF ₃ CH=CHCl	Trans-1-chloro-3,3,3-trifluoro-1-propene	A1	800	5.3
R-1234yf	CF ₃ CF=CH ₂	2, 3, 3, 3-tetrafluoro-1-propene	A2L	500	4.7
R-1234ze(E)	CF ₃ CH=CHF	Trans-1,3,3,3-tetrafluoro-1-propene	A2L	800	4.7
R-1270	CH ₃ CH=CH ₂	Propene (propylene)	A3	500	0.11
R-1336mzz(Z)	CF ₃ CHCHCF ₃	Cis-1,1,1,4,4,4-hexafluoro-2-butene	A1	500	5.4

For SI units: 1 pound = 0.453 kg, 1 cubic foot = 0.0283 m³

Notes:

¹ The preferred chemical name is followed by the popular name in parenthesis.

² The OELs are 8-hour TWAs; a “C” designation denotes a ceiling limit.

³ Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.

⁴ The exact composition of this azeotrope is in question and additional experimental studies are needed.

⁵ R-507, R-508, and R-509 are allowed alternative designations for R-507A, R-508A, and R-509A due to a change in designations after assignment of R-500 through R-509. Corresponding changes were not made for R-500 through R-506.

⁶ The RCL values for these refrigerant blends are approximated in the absence of adequate data for a component comprising less than 4 percent m/m of the blend and expected to have a small influence in an acute, accidental release.

⁷ Refrigerant flammability classification of Class 2L shall comply with the requirements for flammability classification of Class 2.

⁸ In accordance with Section 1102.2, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 34 and is not capable of being modified.

REFRIGERATION

**TABLE 1104.1
PERMISSIBLE REFRIGERATION SYSTEMS¹**

	OCCUPANCY GROUP ³	HIGH-PROBABILITY SYSTEM	LOW PROBABILITY SYSTEM	MACHINERY ROOM
	A-1	Group A1 or A2L ⁴ only	Any	Any
	A-2	Group A1 or A2L ⁴ only	Any	Any
	A-3	Group A1 or A2L ⁴ only	Any	Any
	A-4	Group A1 or A2L ⁴ only	Any	Any
	B	Group A1 ² or A2L ^{2,4} only	Any	Any
	E	Group A1 or A2L ⁴ only	Any	Any
	F-1	Group A1 ² or A2L ^{2,4} only	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 or A2L ⁴ only	Any	Any
	H-5	Group A1 or A2L ⁴ only	Any	Any
	I-1	None	Any	Any
	I-2	Group A1 or A2L ⁴ only	Any	Any
[OSHPD 1, 1R, 2, 3, 4 & 5]	<i>I-2.1</i>	<i>Group A1 only</i>	<i>Any</i>	<i>Any</i>
	I-3	None	Any	Any
	I-4	Group A1 or A2L ⁴ only	Any	Any
	M	Group A1 ² or A2L ^{2,4} only	Any	Any
	R-1	Group A1 or A2L ⁴ only	Any	Any
	R-2	Group A1 or A2L ⁴ only	Any	Any
	R-3	Group A1 or A2L ⁴ only	Any	Any
	R-4	Group A1 or A2L ⁴ only	Any	Any
	S-1	Group A1 ² or A2L ^{2,4} only	Any	Any
	S-2	Any ²	Any	Any
	U	Any	Any	Any

Notes:

¹ See Section 1104.0.

² A refrigerant shall be permitted to be used within a high-probability system where the room or space is in accordance with Section 1104.4.

³ Occupancy classifications are defined in the building code.

⁴ See Section 1104.6 for requirements applicable to A2L equipment.

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 13 – FUEL GAS PIPING**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD					BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4									5
Adopt Entire Chapter	X			X	X			X	X	X	X	X	X	X								
Adopt Entire Chapter as amended (amended sections listed below)			X																			
Adopt only those sections that are listed below																						
Chapter/Section																						
1301.1			X																			

This state agency does not adopt sections identified with the following symbol: †

The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.

CHAPTER 13

FUEL GAS PIPING

1301.0 Scope of Gas Piping.

1301.1 Applicability. The regulations of this chapter shall govern the installation of fuel gas piping in or in connection with a building, structure or within the property lines of premises up to 5 pounds-force per square inch (psi) (34 kPa) for natural gas and 10 psi (69 kPa) for undiluted propane, other than service pipe. Fuel oil piping systems *connected to oil-burning equipment* shall be installed in accordance with NFPA 31. *Fuel oil piping systems connected to internal combustion engines and gas turbines shall be installed in accordance with NFPA 37.*

1302.0 Coverage of Piping System.

1302.1 General. Coverage of piping systems shall extend from the point of delivery to the appliance connections. For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided. For undiluted LP-Gas systems, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators where no meter is installed. Where a meter is installed, the point of delivery shall be the outlet of the meter. [NFPA 54:1.1.1.1(A)]

1302.2 Piping System Requirements. Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation, and maintenance. [NFPA 54:1.1.1.1(E)]

1302.3 Applications. This code shall not apply to the following items:

- (1) Portable LP-Gas appliances and equipment of all types that are not connected to a fixed fuel piping system.
- (2) Installation of appliances such as brooders, dehydrators, dryers, and irrigation equipment used for agricultural purposes.
- (3) Raw material (feedstock) applications except for piping to special atmosphere generators.
- (4) Oxygen-fuel gas cutting and welding systems.
- (5) Industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen, and nitrogen.
- (6) Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms, and natural gas processing plants.
- (7) Large integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by chemical reactions or used in chemical reactions.
- (8) LP-Gas installations at utility gas plants.
- (9) Liquefied natural gas (LNG) installations.
- (10) Fuel gas piping in electric utility power plants.
- (11) Proprietary items of equipment, apparatus, or instruments such as gas-generating sets, compressors, and calorimeters.

- (12) LP-Gas equipment for vaporization, gas mixing, and gas manufacturing.
- (13) LP-Gas piping for buildings under construction or renovations that is not to become part of the permanent building piping system—that is, temporary fixed piping for building heat.
- (14) Installation of LP-Gas systems for railroad switch heating.
- (15) Installation of LP-Gas and compressed natural gas (CNG) systems on vehicles.
- (16) Gas piping, meters, gas pressure regulators, and other appurtenances used by the serving gas supplier in distribution of gas, other than undiluted LP-Gas.
- (17) Building design and construction, except as specified herein.
- (18) Fuel gas systems on recreational vehicles manufactured in accordance with NFPA 1192.
- (19) Fuel gas systems using hydrogen as a fuel.
- (20) Construction of appliances. [NFPA 54:1.1.1.2]

1303.0 Inspection.

1303.1 Inspection Notification. Upon completion of the installation, alteration, or repair of gas piping, and prior to the use thereof, the Authority Having Jurisdiction shall be notified that such gas piping is ready for inspection.

1303.2 Excavation. Excavations required for the installation of underground piping shall be kept open until such time as the piping has been inspected and approved. Where such piping is covered or concealed before such approval, it shall be exposed upon the direction of the Authority Having Jurisdiction.

1303.3 Type of Inspections. The Authority Having Jurisdiction shall make the following inspections and either shall approve that portion of the work as completed or shall notify the permit holder wherein the same fails to be in accordance with this code.

1303.3.1 Rough Piping Inspection. This inspection shall be made after gas piping authorized by the permit has been installed before such piping has been covered or concealed, or before fixture or appliance has been attached thereto. This inspection shall include a determination that the gas piping size, material, and installation meet the requirements of this code.

1303.3.2 Final Piping Inspection. This inspection shall be made after piping authorized by the permit has been installed and after portions thereof that are to be covered or concealed are so concealed and before fixture, appliance, or shutoff valve has been attached thereto. This inspection shall comply with Section

1313.1. Test gauges used in conducting tests shall be in accordance with Section 1303.3.3 through Section 1303.3.3.4.

1303.3.3 Test Gauges. Tests required by this code, which are performed utilizing dial gauges, shall be limited to gauges having the following pressure graduations or increments.

1303.3.3.1 Pressure Tests (10 psi or less). Required pressure tests of 10 psi (69 kPa) or less shall be performed with gauges of 0.10 psi (0.69 kPa) increments or less.

1303.3.3.2 Pressure Tests (greater than 10 psi to 100 psi). Required pressure tests exceeding 10 psi (69 kPa) but less than or equal to 100 psi (689 kPa) shall be performed with gauges of 1 psi (7 kPa) increments or less.

1303.3.3.3 Pressure Tests (exceeding 100 psi). Required pressure tests exceeding 100 psi (689 kPa) shall be performed with gauges of 2 percent increments or less of the required test pressure.

1303.3.3.4 Pressure Range. Test gauges shall have a pressure range not exceeding twice the test pressure applied.

1303.4 Inspection Waived. In cases where the work authorized by the permit consists of a minor installation of additional piping to piping already connected to a gas meter, the foregoing inspections shall be permitted to be waived at the discretion of the Authority Having Jurisdiction. In this event, the Authority Having Jurisdiction shall make such inspection as deemed advisable in order to be assured that the work has been performed in accordance with the intent of this code.

1304.0 Certificate of Inspection.

1304.1 Issuance. Whereupon final piping inspection, the installation is found to be in accordance with the provisions of this code, a certificate of inspection shall be permitted to be issued by the Authority Having Jurisdiction.

1304.2 Gas Supplier. A copy of the certificate of such final piping inspection shall be issued to the serving gas supplier supplying gas to the premises.

1304.3 Unlawful. It shall be unlawful for a serving gas supplier or person furnishing gas, to turn on or cause to be turned on, fuel gas or a gas meter or meters until such certificate of final inspection, as herein provided, has been issued.

1305.0 Authority to Render Gas Service.

1305.1 Authorized Personnel. It shall be unlawful for a person, firm, or corporation, excepting an authorized agent or employee of a person, firm, or corporation engaged in the business of furnishing or supplying gas and whose service pipes supply or connect with the particular premises, to turn on or reconnect gas service in or on a premises where gas service is, at the time, not being rendered.

1305.2 Outlets. It shall be unlawful to turn on or connect gas in or on the premises unless outlets are securely connected to gas appliances or capped or plugged with screw joint fittings.

1306.0 Authority to Disconnect.

1306.1 Disconnection. The Authority Having Jurisdiction or the serving gas supplier is hereby authorized to disconnect gas piping or appliance or both that shall be found not to be in accordance with the requirements of this code or that are found defective and in such condition as to endanger life or property.

1306.2 Notice. Where such disconnection has been made, a notice shall be attached to such gas piping or appliance or both that shall state the same has been disconnected, together with the reasons thereof.

1306.3 Capped Outlets. It shall be unlawful to remove or disconnect gas piping or gas appliance without capping or plugging with a screw joint fitting, the outlet from which said pipe or appliance was removed. Outlets to which gas appliances are not connected shall be left capped and gastight on a piping system that has been installed, altered, or repaired.

Exception: Where an approved listed quick-disconnect device is used.

1307.0 Temporary Use of Gas.

1307.1 General. Where temporary use of gas is desired, and the Authority Having Jurisdiction deems the use necessary, a permit shall be permitted to be issued for such use for a period of time not to exceed that designated by the Authority Having Jurisdiction, provided that such gas piping system otherwise is in accordance with to the requirements of this code regarding material, sizing, and safety.

1308.0 Gas Piping System Design, Materials, and Components.

1308.1 Installation of Piping System. Where required by the Authority Having Jurisdiction, a piping sketch or plan shall be prepared before proceeding with the installation. The plan shall show the proposed location of piping, the size of different branches, the various load demands, and the location of the point of delivery. [NFPA 54:5.1.1]

1308.1.1 Addition to Existing System. When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity. If the capacity of the system is determined to be inadequate for the additional appliances, the existing system shall be enlarged as required, or separate gas piping of adequate capacity shall be provided. [NFPA 54:5.1.2]

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

1308.3 Interconnections Between Gas Piping Systems. Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators. [NFPA 54:5.3.1]

1308.3.1 Interconnections for Standby Fuels. Where a supplementary gas for standby use is connected downstream from a meter or a service regulator where a

**CALIFORNIA MECHANICAL CODE – MATRIX ADOPTION TABLE
CHAPTER 16 – STATIONARY POWER PLANTS**

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD			DSA			OSHPD					BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1-AC	AC	SS	SS/CC	1	1R	2	3	4									5
Adopt Entire Chapter	X			X	X			X	X													
Adopt Entire Chapter as amended (amended sections listed below)			X																			
Adopt only those sections that are listed below																						
Chapter/Section																						
1602.1			X																			
1602.2			X																			

This state agency does not adopt sections identified with the following symbol: †

The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.0.

CHAPTER 16

STATIONARY POWER PLANTS

1601.0 Stationary Fuel Cell Power Plants.

1601.1 General. Fuel cell power plants with a power output of less than 50 kW shall be listed and installed in accordance with the manufacturer's instructions. Fuel cell power plants with a power output of greater than 50 kW shall be installed in accordance with NFPA 853. [NFPA 54:10.30] Stationary fuel cell power plants shall be tested in accordance with CSA FC-1.

1602.0 Stationary Engines, Generators and Gas Turbines.

1602.1 Gas Engines. The installation of *stationary* gas engines shall conform to NFPA 37. [NFPA 54:10.23]

1602.1.1 Connection to the Gas Supply Piping.

Stationary gas engines shall not be rigidly connected to the gas supply piping. [NFPA 54:10.23.1]

1602.2 Liquid-Fueled Engines and Gas Turbines. *In accordance with California Building Code Section 442.1, the installation of liquid-fueled stationary internal combustion engines and gas turbines shall conform to NFPA 37.*

1602.3 Stationary Engine Generators. Stationary engine generators shall be tested in accordance with UL 2200, and shall be installed in accordance with NFPA 37 and the manufacturer's installation instructions.

CHAPTER 17

REFERENCED STANDARDS

1701.0 General.

1701.1 Standards. The standards listed in Table 1701.1 are referenced in various sections of this code and shall be considered part of the requirements of this document. The standards are listed herein by the standard number and effective

date, the title, application and the section(s) of this code that reference the standard. The application of the referenced standard(s) shall be as specified in Section 302.1.2.

The promulgating agency acronym referred to in Table 1701.1 are defined in a list found at the end of the table.

**TABLE 1701.1
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
49 CFR 192.281	Plastic Pipe	Piping, Plastic	1308.5.4.2.2
49 CFR 192.283	Plastic Pipe: Qualifying Joining Procedures	Piping, Plastic	1308.5.4.2.2
AABC-2016	Total System Balance, 7th Edition	Balancing	314.1(1)
ACCA Manual B-2009	Balancing and Testing Air and Hydronic Systems	Balancing	314.1(2)
ACCA Manual D-2016	Residential Duct Systems	Ducts, Balancing	601.2
ACCA Manual J-2016	Residential Load Calculations	Ducts	1105.1
ACCA Manual S-2014	Residential Equipment Selection	Equipment	1105.1
ACCA Manual Zr-2018	Residential Zoning	Ducts	601.2
ACCA 4 QM-2019	Maintenance of Residential HVAC Systems	HVAC Systems	102.3.2
AHRI 700-2017a	Specifications for Refrigerants	Refrigerants	1104.8, 1104.8.3
AMCA 540-2013	Louvers Impacted by Wind Borne Debris	Louvers	315.1.2
AMCA 550-2015	Test Method for High Velocity Wind Driven Rain Resistant Louvers	Louvers	315.1.1
ASHRAE 15-2022	Safety Standard for Refrigeration Systems	Refrigeration Systems	1102.1, 1106.1, Table 1113.5
ASHRAE 34-2022	Designation and Safety Classification of Refrigerants	Refrigeration Classifications	1102.3, 1103.1, Table 1102.3
ASHRAE 62.1-2016	Ventilation for Acceptable Indoor Air Quality	Indoor Air Quality Ventilation	402.4.1
ASHRAE 111-2008	Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems	Balancing	314.1(3)
ASHRAE 129-1997 (R2002)	Measuring Air-Change Effectiveness	Air Change Effectiveness	Table 403.2.2
ASHRAE 154-2016	Ventilation for Commercial Cooking Operations	Commercial Kitchens	510.5.6
ASHRAE 170-2013	Ventilation of Health Care Facilities	Ventilation	402.1.2
ASHRAE/ACCA 180-2018	Inspection and Maintenance of Commercial Building HVAC Systems	Maintenance	102.3.1, 1013.3
ASHRAE Handbook-2017	Fundamentals	Climatic Conditions	Figure 803.1.2(6)

REFERENCED STANDARDS

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASME B1.20.1-2013	Pipe Threads, General Purpose (Inch)	Joints	1211.2(3), 1211.4(7), 1211.12(3), 1211.13(2), 1308.5.6
ASME B16.1-2015	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250	Fittings	1308.5.9
ASME B16.3-2016	Malleable Iron Threaded Fittings: Classes 150 and 300	Fittings	Table 1210.1
ASME B16.5-2017	Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch	Fittings	Table 1210.1, 1308.5.9.1(1)
ASME B16.9-2018	Factory-Made Wrought Buttwelding Fittings	Fittings	Table 1210.1
ASME B16.11-2016	Forged Fittings, Socket-Welding and Threaded	Fittings	Table 1210.1
ASME B16.15-2018	Cast Copper Alloy Threaded Fittings: Classes 125 and 250	Fittings	Table 1210.1
ASME B16.18-2018	Cast Copper Alloy Solder Joint Pressure Fittings	Fittings	Table 1210.1
ASME B16.20-2017	Metallic Gaskets for Pipe Flanges	Joints	1308.5.10.2
ASME B16.21-2016	Nonmetallic Flat Gaskets for Pipe Flanges	Fuel Gas Piping	1308.5.10.3
ASME B16.22-2018	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings	Fittings	Table 1210.1
ASME B16.23-2016	Cast Copper Alloy Solder Joint Drainage Fittings: DWV	Fittings	Table 1210.1
ASME B16.24-2016	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500	Fittings	Table 1210.1, 1308.5.9.2
ASME B16.26-2018	Cast Copper Alloy Fittings for Flared Copper Tubes	Fittings	Table 1210.1
ASME B16.29-2017	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV	Fittings	Table 1210.1
ASME B16.42-2016	Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300	Fuel Gas Piping	1308.5.9.3
ASME B16.47-2017	Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch	Fuel Gas Piping	1308.5.9.1(2)
ASME B16.51-2018	Copper and Copper Alloy Press-Connect Pressure Fittings	Fittings	Table 1210.1
ASME B31.3-2016	Process Piping	Process Piping	1406.1
ASME B31.5-2016	Refrigeration Piping and Heat Transfer Components	Refrigeration Piping	1109.1.1, 1109.1.3
ASME B36.10M-2018	Welded and Seamless Wrought Steel Pipe	Fuel Gas Piping	1308.5.2.1
ASME BPVC Section I-2017	Rules for Construction of Power Boilers	Boilers	1002.1(1), Table 1003.2.1
ASME BPVC Section IV-2017	Rules for Construction of Heating Boilers	Boilers	1002.1(2)
ASME BPVC Section VIII.1-2017	Rules for Construction of Pressure Vessels Division 1	Pressure Vessels	1002.1, 1004.3, 1112.10.1, 1112.13, 1113.1, 1115.4, 1115.4.1, 1117.1(2), 1117.1(3), 1117.2, 1209.4

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
AWWA C901-2017	Polyethylene (PE) Pressure Pipe and Tubing, ¾ in. (19 mm) Through 3 in. (76 mm) for Water Service	Piping, Plastic	Table 1210.1
CSA B137.1-2017	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services	Piping	Table 1210.1
CSA B137.2-2017	Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications	Piping, Plastic	Table 1210.1
CSA B137.3-2017	Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications	Piping, Plastic	Table 1210.1
CSA B137.5-2017	Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications	Piping	Table 1210.1
CSA B137.6-2017	Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems	Piping, Plastic	Table 1210.1
CSA B137.9-2017	Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure-Pipe Systems	Piping	Table 1210.1
CSA B137.10-2017	Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Composite Pressure-Pipe Systems	Piping	Table 1210.1
CSA B137.11-2017	Polypropylene (PP-R) Pipe and Fittings for Pressure Applications	Piping	1211.11(1), Table 1210.1
CSA B137.18-2017	Polyethylene of Raised Temperature Resistance (PE-RT) Tubing Systems for Pressure Applications	Piping, Plastic	Table 1210.1
CSA FC 1-2014	Fuel Cell Technologies-Part 3-100: Stationary Fuel Cell Power Systems-Safety	Fuel Cell Power Plants	1601.1
CSA LC 1-2018	Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (same as CSA 6.26)	Fuel Gas	1308.5.3.5, 1310.4.1(4), 1311.3
CSA LC 4a-2013 (R2017)	Press-Connect Metallic Fittings For Use in Fuel Gas Distribution Systems (same as CSA 6.32a)	Fuel Gas	1308.5.7.1, 1308.5.7.2, 1308.5.7.3, 1310.4.1(3)
CSA NGV 5.1-2016	Residential Fueling Appliances	Appliances	938.1
CSA Z21.8-1994 (R2017)	Installation of Domestic Gas Conversion Burners	Fuel Gas, Appliances	909.1
CSA Z21.10.1-2017	Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less (same as CSA 4.1)	Fuel Gas, Appliances	Table 1203.2
CSA Z21.10.3-2017	Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous (same as CSA 4.3)	Fuel Gas, Appliances	Table 1203.2
CSA Z21.24-2015	Connectors for Gas Appliances (same as CSA 6.10)	Fuel Gas	1312.1(3), 1312.2
CSA Z21.41-2014	Quick Disconnect Devices for Use with Gas Fuel Appliances (same as CSA 6.9)	Fuel Gas	1312.7
CSA Z21.54-2014	Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances (same as CSA 8.4)	Fuel Gas	1312.3.2
CSA Z21.69-2015	Connectors for Moveable Gas Appliances (same as CSA 6.16)	Fuel Gas	1312.1.1
CSA Z21.75-2016	Connectors for Outdoor Gas Appliances and Manufactured Homes (same as CSA 6.27)	Appliances	1312.1(4)
CSA Z21.80a-2012	Line Pressure Regulators (same as CSA 6.22a)	Fuel Gas	1308.7.1, 1308.7.4(1)
CSA Z21.90-2015	Gas Convenience Outlets and Optional Enclosures (same as CSA 6.24)	Gas Outlets	1312.8
CSA Z21.93-2017	Excess Flow Valves for Natural and Propane Gas with Pressures up to 5 psig (same as CSA 6.30)	Fuel Gas	1309.1

REFERENCED STANDARDS

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
CSA Z83.4-2017	Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application (same as CSA 3.7)	Air Heaters, Non-Recirculating, Non-Recirculating Heaters	914.1
CSA Z83.18-2017	Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Applications	Air Heaters, Industrial Heaters, Recirculating	915.1
IAPMO PS 117-2017	Press and Nail Connections	Fittings	Table 1210.1
IAR 2-2014	Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems	Ammonia Refrigeration Systems	1102.2
IAR 3-2017	Ammonia Refrigeration Valves	Ammonia Refrigeration Systems	1102.2
IAR 4-2015	Installation of Closed-Circuit Ammonia Refrigeration Systems	Ammonia Refrigeration	1102.2
IAR 5-2013	Start-Up and Commissioning of Closed Circuit Ammonia Refrigeration Systems	Ammonia Refrigeration Systems	1102.2
MSS SP-58-2018	Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application, and Installation	Miscellaneous	1310.3.5
NEBB-2015	Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems, 8 th Edition	Balancing	314.1(4)
NFPA 2-2019	Hydrogen Technologies Code	Gaseous Hydrogen Systems	937.1
NFPA 10-2021	Portable Fire Extinguishers	Fire Extinguishing	513.10, 513.10.1, 513.11, 517.7.4
NFPA 12-2018	Carbon Dioxide Extinguishing Systems	Fire Extinguishing	513.2.3(1)
NFPA 13-2022 <i>*See California Fire Code for amendments</i>	Installation of Sprinkler Systems	Miscellaneous	513.2.3(2), 517.7.6
NFPA 17-2020	Dry Chemical Extinguishing Systems	Fire Extinguishing	513.2.3(3), 513.3.5
NFPA 17A-2020	Wet Chemical Extinguishing Systems	Fire Extinguishing	513.2.3(4), 513.2.5.6, 513.3.5
NFPA 30A-2021	Motor Fuel Dispensing Facilities and Repair Garages	Miscellaneous	303.11.1
NFPA 31-2016	Installation of Oil-Burning Equipment	Fuel Gas, Appliances	301.5, 1002.2.2, 1301.1
NFPA 37-2018	Installation and Use of Stationary Combustion Engines and Gas Turbines	Generators, <i>Fuel oil piping systems</i>	1301.1, 1602.1, 1602.2, 1602.3
NFPA 51-2018	Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes	Fuel Gas Systems	902.7
NFPA 52-2019	Vehicular Natural Gas Fuel Systems Code	CNG Vehicle Fuel Systems	938.1
NFPA 54/Z223.1-2018	National Fuel Gas Code	Fuel Gas	516.2.1
NFPA 58-2020	Liquefied Petroleum Gas Code	Fuel Gas	303.7, 516.2.1, 1308.5.4.2.3, 1308.5.8.4, 1310.6(7), 1312.11
NFPA 68-2018	Explosion Protection by Deflagration Venting	Product Conveying Ducts	505.3.3

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
NFPA 69-2019	Explosion Prevention Systems	Explosion Prevention	505.3.1
NFPA 70-2020 <i>*See California Electrical Code for amendments</i>	National Electrical Code	Miscellaneous	301.4(1), 301.4(3), 511.1.6, 512.2.5, 516.2.7, 516.2.9(4), 602.2.1, 905.8.2, 1104.4(5), 1107.1.7, 1107.1.8, 1217.8.1, 1310.14.5(2), 1311.2.4, 1311.7
NFPA 80-2019	Fire Doors and Other Opening Protectives	Fire Doors	510.7.7
NFPA 82-2019	Incinerators and Waste and Linen Handling Systems and Equipment	Incinerator Chutes	802.2.8, Table 802.4, 925.1
NFPA 85-2019	Boiler and Combustion Systems Hazards Code	Appliances	1002.1(3), 1011.1, Table 1003.2.1
NFPA 86-2019	Ovens and Furnaces	Product Conveying Ducts	505.3.2
NFPA 88A-2019	Parking Structures	Miscellaneous	303.11
NFPA 90A-2018	Installation of Air-Conditioning and Ventilating Systems	HVAC	604.1
NFPA 90B-2018	Installation of Warm Air Heating and Air-Conditioning Systems	HVAC	604.1
NFPA 211-2019	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances	Fuel Gas Appliances	517.7, 517.7.1, 801.2, 801.3, 802.5.2, 802.5.3, 802.5.7.1, 802.5.7.3, 902.10
NFPA 262-2019	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces	Certification	602.2.1
NFPA 409-2022	Aircraft Hangars	Miscellaneous	303.12
NFPA 654-2020	Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids	Dust Explosion Prevention, Gutters	506.6, Table 505.9
NFPA 780-2017	Installation of Lightning Protection Systems	Fuel Gas	1311.5
NFPA 853-2020	Installation of Stationary Fuel Cell Power Systems	Fuel Cell Power Plants, Fuel Cells	1601.1
NFPA 1192-2018	Recreational Vehicles	Fuel Gas Piping	1302.3(18)
NSF 358-1-2017	Polyethylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Plastic	Table 1210.1
NSF 358-2-2017	Polypropylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Plastic	Table 1210.1
NSF 358-3-2016	Cross-linked polyethylene (PEX) pipe and fittings for water-based ground-source (geothermal) heat pump systems	Piping, Plastic	Table 1210.1
SMACNA-2002	HVAC Systems Testing, Adjusting and Balancing, 3rd Edition	Balancing	314.1(5)
SMACNA-2017	HVAC Duct Construction Standards Metal and Flexible, 4 th Edition	Ducts, Metal and Flexible	504.4.5, 506.2, 602.3, 603.3, 603.4, 603.7.1, 603.9, 603.11, 605.1
SMACNA-2012	HVAC Air Duct Leakage Test Manual, 2 nd Edition	Ducts	603.9.2, 603.10

REFERENCED STANDARDS

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
SMACNA-2015	Phenolic Duct Construction Standards	Duct Systems	602.4.1
UL 17-2008	Vent or Chimney Connector Dampers for Oil-Fired Appliances (with revisions through September 25, 2013)	Vent Dampers	802.15.1
UL 103-2010	Factory-Built Chimneys for Residential Type and Building Heating Appliances (with revisions through March 15, 2017)	Fuel Gas, Appliances	802.5.1, 802.5.1.1
UL 127-2011	Factory-Built Fireplaces (with revisions through July 27, 2016)	Fireplaces	802.5.1.1, 913.1, 913.1.1
UL 181-2013	Factory-Made Air Ducts and Air Connectors (with revisions through April 18, 2017)	Air Connectors, Air Ducts	602.3, 602.4.1, 602.4.4, 603.1.4, 603.1.5, 603.4, 603.9.1, 605.1.1, Table 603.9.1
UL 181A-2013	Closure Systems for Use with Rigid Air Ducts (with revisions through March 22, 2017)	Air Ducts	603.9.1, Table 603.9.1
UL 181B-2013	Closure Systems for Use with Flexible Air Ducts and Air Connectors (with revisions through March 21, 2017)	Air Connectors, Air Ducts	603.9.1, Table 603.9.1
UL 197-2010	Commercial Electric Cooking Appliances (with revisions through January 26, 2018)	Appliances, Commercial Cooking, Electric Appliances	921.1
UL 207-2009	Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014)	Refrigeration Components	1109.2
UL 268A-2008	Smoke Detectors for Duct Application (with revisions through August 12, 2016)	Smoke Detectors	609.1
UL 295-2017	Commercial-Industrial Gas Burners	Gas Burners	910.2
UL 296-2017	Oil Burners (with revisions through November 29, 2017)	Fuel Gas, Appliances	910.1
UL 300-2005	Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment (with revisions through December 16, 2014)	Certification	513.2.2, 513.2.5, 517.3.1.1(6)
UL 378-2006	Draft Equipment (with revisions through September 17, 2013)	Fuel Gas, Appliances	802.3.3, 802.15.1
UL 391-2010	Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces (with revisions through June 12, 2014)	Furnaces, Solid Fuel	904.10
UL 412-2011	Refrigeration Unit Coolers (with revisions through August 28, 2018)	Refrigeration	934.2
UL 427-2011	Refrigerating Units (with revisions through February 10, 2017)	Refrigeration Systems	934.3
UL 441-2016	Gas Vents (with revisions through July 27, 2016)	Fuel Gas	802.1
UL 467-2013	Grounding and Bonding Equipment	Grounding and Bonding	1311.2.5
UL 471-2010	Commercial Refrigerators and Freezers (with revisions through November 8, 2018)	Freezers, Refrigerators	934.1
UL 499-2014	Electric Heating Appliances (with revisions through February 23, 2017)	Kilns	931.4
UL 555-2006	Fire Dampers (with revisions through October 21, 2016)	Dampers	606.2
UL 555C-2014	Ceiling Dampers (with revisions through May 1, 2017)	Dampers	606.3
UL 555S-2014	Smoke Dampers (with revisions through October 27, 2016)	Dampers	606.1
UL 641-2010	Type L Low-Temperature Venting Systems (with revisions through April 23, 2018)	Equipment	802.1

**TABLE 1701.1 (continued)
REFERENCED STANDARDS**

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
UL 60335-2-40-2022, <i>4th Edition</i>	Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers	Appliances	903.1, 904.13
UL 60335-2-89-2021	Household and Similar Electrical Appliances – Safety – Part 2-89: Particular Requirements for Commercial Refrigerating Appliances with an Incorporated or Remote Refrigerant Unit or Compressor	Appliances	934.1, 934.2, 934.3

REFERENCED STANDARDS

1701.2 Standards, Publications, Practices, and Guides.

The standards, publications, practices and guides listed in Table 1701.2 are not referenced in other sections of this code. The

application of the referenced standards, publications, practices and guides shall be as specified in Section 302.1.2. The promulgating agency acronyms are found at the end of the table.

**TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ACCA Manual N-2012	Commercial Load Calculations	Ducts
ACCA Manual Q-1990	Low Pressure, Low Velocity Duct System Design	Ducts
AHRI 870-2016	Performance Rating of Direct Geexchange Heat Pumps	Heat Pumps
AHRI 1200-2013	Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets	Commercial Refrigerated Display Merchandisers and Storage Cabinets
AHRI 1230-2014a	Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment	Refrigerants
AMCA 500-D-2018	Laboratory Methods of Testing Dampers for Rating	Dampers
ASCE 25-2016	Earthquake-Actuated Automatic Gas Shutoff Devices	Fuel Gas
ASHRAE 52.2-2012	General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size	Cleaning Devices
ASHRAE 55-2017	Thermal Environmental Conditions for Human Occupancy	Miscellaneous
ASHRAE 62.2-2016	Ventilation and Acceptable Indoor Air Quality in Residential Buildings	Ventilation
ASHRAE/IES 90.1-2016	Energy Standard for Buildings Except Low-Rise Residential Buildings	Energy
ASHRAE/IES 90.2-2018	Energy-Efficient Design of Low-Rise Residential Buildings	Energy, Dwellings
ASHRAE 127-2012	Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners	Air Conditioners
ASHRAE/ACCA 183-2007 (R2017)	Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings	Cooling and Heating Load, Miscellaneous
ASHRAE 194-2012	Method of Test for Direct-Expansion Ground-Source Heat Pumps	Ground-Source Heat Pumps
ASHRAE Handbook-2016	HVAC Systems and Equipment	Design
ASME A13.1-2015	Scheme for the Identification of Piping Systems	Piping
ASME A112.18.6/CSA B125.6-2017	Flexible Water Connectors	Piping
ASME B1.20.3-1976 (R2018)	Dryseal Pipe Threads (Inch)	Joints
ASME B16.33-2012 (R2017)	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS ½ through NPS 2)	Valves
ASME B16.50-2018	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings	Fittings
ASTM A568/A568M-2017a	Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for	Piping
ASTM A653/A653M-2017	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process	Piping, Ferrous
ASTM A733-2016	Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples	Piping, Ferrous

INDEX

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– A –

ABSORPTION SYSTEM

- Cooling system Chapter 11
- Duct system Chapter 6

ABSORPTION UNIT

- Definition 203.0
- Labeling 307.4

ACCEPTED ENGINEERING

- PRACTICE** 203.0, 309.1

ACCESS PANELS

- Definition 203.0
- Ducts connected to
 - duct furnaces 905.3
- Exhaust systems,
 - commercial kitchen 510.1.5, 510.3.1, 510.3.6, 510.3.6.2, 514.4.8, 514.4.10

ACCESSIBILITY FOR

- Inspections 105.1
- Service 304.0

ACCESSIBILITY OF

- Appliances and equipment 304.1, 304.3, 304.4
- Appliances and equipment
 - on roof 304.3
- Boilers 1010.0
- Cleanouts 802.5.10
- Draft hoods 802.12.5
- Drips, fuel gas piping 1310.9.1
- Evaporative coolers 933.3
- Fire dampers 606.5
- Floor furnace 906.8
- Fuel gas meters 1308.6.1, D 104.2
- Fuel gas piping 1310.3.3.1
- Fuel gas pressure regulators 1308.7.2, 1310.5.1
- Grease filters 509.2.3.2
- Lapped flanges 1308.5.9.6
- Motors and fans, exhaust systems 503.1
- Refrigeration equipment 1105.3
- Smoke dampers 606.5

ACCESSIBLE

- Definition 203.0
- Easily, definition 207.0
- Readily, definition 203.0

ADMINISTRATION Chapter 1

- California* *Chapter 1, Division I*
- General Chapter 1, *Division II*

AIR

- Balancing 314.0, 511.3.1, E 503.6.5.3

- Classification 403.9
- Combustion (see Combustion Air)
- Dilution 203.0, 701.1, 802.6.3.1, 902.12
- Ducts (see Ducts)
- Economizer (see Economizer, air)
- Exhaust (see Air, exhaust)
- Filters (see Filters, air)
- Furnace (see Furnaces, warm air)
- Heaters (see Heater, air)
- Makeup 203.0, 403.7, 504.1, 504.4.1, 511.3, 517.1.3, 517.6.1, 517.6.2, 701.3, 931.5.4, 1106.6
- Moving Systems 203.0, 609.1
- Outside 203.0, 311.1, 311.3
- Pollution control
 - devices 203.0, 512.3.3, 512.3.5
- Recirculation 403.7, 403.9, 512.3.5
- Replacement (see Air, makeup)
- Return 203.0, 311.1, 311.3, 311.4
- Supply 203.0, Chapter 4, 914.5, 915.5
- Transfer 403.7, 603.9.2, E 503.5.11.1
- Ventilation Chapter 4

AIR CONDITIONED

- Definition 203.0

AIR CONDITIONING

- Coils 903.2.5
- Gas fired type 903.2
- Refrigerant port protection 1105.11
- System test E 805.0
- System water use E 403.0

AIR-HANDLING UNIT

- Definition 203.0
- Ducts Chapter 6
- System test E 805.0

AIR, EXHAUST

- Cross Contamination 603.10
- Definition 203.0
- Openings 305.3.2
- Grease filters 509.2.3.1
- Ventilation 403.7
- Volumes 511.2.2

ALARMS 416.0, 418.5

ALTERNATE MATERIALS AND METHODS

- CONSTRUCTION EQUIVALENCY** 302.2

ALTERNATIVE ENGINEERING DESIGN

- Design approval 302.3.4
- Design document 302.3.3
- Design review 302.3.5

INDEX

Inspection and testing 302.3.6
 Permit application 302.3.1
 Technical data 302.3.2
AMMONIA 1102.1, 1104.4, 1102.2,
 1102.3, 1106.2, Table 1102.3
ANCHORAGE OF
 Appliances 303.4
 Boilers and pressure vessels 1001.5
 Cooling towers 1120.0
 Evaporative condensers 1120.0
 Fluid coolers 1120.0
 Refrigeration equipment
 and piping 1105.2
ANODELESS RISER 203.0, 1308.5.4.2
APPEALS 107.0
APPLIANCE FLUE OUTLET
 Definition 203.0
APPLIANCES
 Access to 304.0
 Air filter 936.0
 Approval of 301.2
 Clearance 303.3, 303.10, 303.10.1,
 Table 303.10.1, Table 802.7.3.3
 Closed combustion
 solid-fuel-burning, definition 205.0
 Clothes dryers (see Clothes dryer)
 Cooking 517.2–517.2.2, 517.7, 517.7.2,
 517.8, 517.8.1, 920.0, 921.0, 923.0
 Decorative, vented 224.0, 911.0, 932.0
 Definition 203.0
 Direct vent 206.0, 802.2.6, 802.8.2
 Downdraft 518.0
 Electric cooling 307.3
 Electric heating 207.0, 307.2, 903.1, 905.8
 Fan-assisted
 combustion 203.0, 802.6.2.1, 802.10.2
 Floor furnaces (see Furnaces, floor furnace)
 Food service 918.0, 919.0
 Heating 306.1
 Household cooking 920.0
 Illuminating 924.0, Table 924.2.1
 In attics 304.4–304.4.4
 In garages 305.1, 305.1.1, 905.7
 In manufactured housing 930.0
 In under-floor spaces 304.4–304.4.4
 Kilns 931.0
 Labeling of 307.0
 Listed 303.1
 Location of 305.0
 Low-heat 203.0, 801.2
 Medium-heat 203.0, 801.2
 Movement of 303.5
 Oil-burning 301.5, 904.11, 906.13,
 907.4, 917.6, 921.3
 On roofs 303.8

Open-top broiler units (see Broiler units)
 Outdoor cooking 923.0
 Pit location 305.2
 Protection against
 flood damage 305.3
 Range 920.1, 921.1, 921.3
 Refrigeration 934.0
 Refrigerators (see Refrigerators)
 Room heaters (see Heater, room)
 Solid-fuel burning 902.10, 904.10, 916.3, 1002.4
 Unit heaters (see Heater)
 Unlisted 303.3, 303.10
 Venting of Chapter 8
APPROVED
 Definition 203.0
APPROVED TESTING AGENCY
 Definition 203.0
ATTIC INSTALLATIONS
 Appliances 304.4–304.4.4
AUTHORITY HAVING JURISDICTION
 Authority to disconnect
 of gas piping 1306.0
 Authority to render gas service 1305.0
 Condemn equipment 106.6
 Connection approval 105.4
 Cooperation of other
 officials and officers 103.1
 Definition 203.0
 Deputize 103.1
 Disconnect utilities in
 emergencies, to 106.5
 Inspections 105.0, 1013.0
 Issues permits 104.4
 Liability 103.2
 Limitations of authority 107.2
 Powers and duties 103.0
 Right of entry 103.4
 Stop orders 106.4
 Temporary connection 105.4, 1307.1
 Testing 105.3, 302.2.1
AUTOMATIC
CONTROL DEVICES 306.0
AUTOMATIC, BOILERS (see Boiler types,
 automatic)

AZEOTROPE
 Allowable quantities Table 1102.3
 Definition 203.0

– B –

BAFFLE PLATE 204.0, 509.2.2.1,
 509.2.2.2, 509.2.2.3
BALANCING, HVAC 314.0, E 502.3
 E 503.6.5.3–E 503.6.5.3.2
BLEED LINES 902.16
BOARD OF APPEALS 107.0

From category I and category III appliances 802.8.3, 802.9.1

From category II and category IV appliances 802.8.3, 802.9

From fuel gas piping 1310.8, 1310.8.1

From noncategorized appliances 802.8.3, 802.9

From refrigeration coils 904.7

Point of discharge 310.5

Pumps 310.1.1

Waste pipe sizing 310.3, Table 310.3

CONDENSER

Definition 205.0

CONDENSING APPLIANCE

Definition 205.0

CONDENSING UNIT

Definition 205.0

CONDITIONED SPACE

Definition 205.0

CONFINED SPACE

Definition 205.0

CONFLICTS BETWEEN CODES 102.1

CONNECTORS

Appliances, category I 802.10, 802.10.1–802.10.12.1, Table 802.10.1.3

Appliances, category II, III, and IV 802.11

Appliance fuel connector 203.0, 1312.1, 1312.1.1, 1312.3, 1312.5.2, 1312.5.3

Boilers Table 802.7.3.3

Chimney 205.0, 802.5.5, 802.10.1.3, Table 303.10.1, Table 802.10.1.3

Clearances Table 303.10.1, Table 802.7.3.3

Flexible connectors 1312.5.2, 1312.5.3

Gas vent 224.0, 802.2, 802.3.3.3, 802.5.5, 802.10–802.10.12.1, 802.11, 803.2–803.2.3, 803.2.11, 803.2.14, 803.2.21–803.2.23, Table 303.10.1, Table 802.7.3.3, Table 802.10.1.3, Table 803.2.1

Incinerators Table 802.10.1.3

Multiple appliances 803.2

Vibration Isolation 510.9.1.1

CONSTRUCTION DOCUMENTS

Definitions 205.0

For Permits 103.3, 104.3.1

CONTAINERS FOR

Grease 509.2.4.1

Liquid petroleum gas (LP-Gas) D 104.3

Oil tanks D 113.6.2

Refrigerants (see Refrigerants, containers)

CONTINUOUS ENCLOSURE 205.0, 510.7

COOLING

Air system 311.0

Coil 904.7

Evaporative cooling system 207.0, 933.0

System, definition 205.0

Towers Chapter 11 (Part II)

Unit 205.0, 904.8

COPPER OR COPPER ALLOY PIPE AND TUBING 1211.3

CORRUGATED STAINLESS STEEL TUBING (CSST)

Bonding of 1311.2

Definition 205.0

Support 1310.3.5

Test pressure 1313.3

CREMATORIES

Factory built 926.2

CROSS-LINKED POLYETHYLENE (PEX) PIPING OR TUBING

Definition 218.0

Ground source loop Table F 104.2, Table F 104.3

Hydronics 1210.0, Table 1210.1, Table 1220.4.1

Joining and connections (see Joints and connections)

Oxygen diffusion 1210.4

CROSS-LINKED POLYETHYLENE-ALUMINUM-CROSS-LINKED POLYETHYLENE (PEX-AL-PEX) PIPING OR TUBING

Definition 218.0

Hydronics 1210.0, Table 1210.1

Joining and connections (see Joints and connections)

– D –

DAMPERS

Automatically operated 802.15, 802.15.1, E 502.10.2

Backdraft 504.1.1, 504.4, 1106.6 II

Balancing E 502.3.1

Ceiling radiation 206.0, 606.3

Chimney, free opening area Table 911.2

Combination fire and smoke 206.0

Definition 206.0

Economizers E 503.5.1.1

Fire 206.0, 508.3.5.3, 508.3.5.3.1, 511.4.2, 516.2.6, 606.2, 606.5, 933.1

Fire and smoke, access to 606.5

Freedom from interference 606.6

Heating, ventilation, and air conditioning E 502.12

HVAC system tests of E 805.0

Identification of 606.5

In ducts, commercial

INDEX

kitchen exhaust 512.1, 512.1.1
In duct furnace 905.6
Manually operated 802.13, E 502.10.2
Maximum leakage E 503.4.6.4.2
Motorized, nonrecirculating
air heating. 914.7, E 503.4.6.4.1
Multiple arrangements 606.4
Return air E 503.5.1.3, E 805.5.1.2,
E 805.5.2, E 805.12.1.1
Smoke. 206.0, 606.1, 606.5
Supply air E 503.4.6.4.1, E 503.4.6.4.2
Stack 1003.4
Vent 802.13, 802.15, 802.15.1, C 109.1
Volume 206.0

DECORATIVE

APPLIANCES, VENTED (see Appliances)

DEFINITIONS Chapter 2

DEPARTMENT

Definition. 206.0

DESIGN

Requirements for Ethylene Oxide (ETO)

Sterilization areas 418.0

DESIGN FLOOD ELEVATION. 206.0

DEVICES

Automatic carbon monoxide 403.72

Automatic control 306.0

Detection 206.0, 514.2.3

Draft control, fuel gas vent 802.12.2

Grease removal 209.0, 507.4, 507.4.1,
509.0, 513.1.2,
514.4.2, 517.5, 517.7.1

Pressure limiting 218.0, 904.4, 927.3, 1111.0

Pressure relief 218.0, 904.6, 1112.0,
1113.0, 1115.4, 1206.1

Quick-disconnect 219.0, 1312.3.2, 1312.7

DISTRICT HEATING PLANT

Definition. 206.0

DRAFT CONTROLS 802.12

DRAFT HOODS. 206.0, 802.5.5, 802.6.2

DRAINAGE

Boiler rooms. 1001.4

Cooling tower 1121.0

Hydronic piping system 1221.4

DRAINAGE PANS 305.5, 310.2, 1105.7

DUCTLESS MINI-SPLIT SYSTEMS 935.0

DUCT(S) Chapter 6

Air Dispersion 602.4.3, 603.12

Clothes dryers. 504.4, 504.4.2

Combustion air 701.6.1, 701.11, 701.12

Combustibles within 602.2

Construction of
(product conveying) 506.2

Cross contamination 603.10

Definition. 206.0

Domestic range vents 504.3

Duct 409.0

Environmental air 207.0, 504.0

Exhaust, commercial kitchen 510.0

Existing metal 102.2

Factory-made air. 603.4, 603.4.1, 603.7

Fire protection required 506.8

Flexible air ducts and connectors 603.4, 603.7.2

For kilns 603.13.6, 931.5.3, 931.6

Furnace 206.0, 905.0

Gravity ventilation. 931.5.3

Grease type 209.0, 510.0

Gypsum wallboard 504.6, 602.4.2

In under floor or crawl spaces. 603.2

Inspection and cleaning of 514.2, 514.4.2

Insulation of 605.0, E 502.4.1,
E 503.4.7.1,

Table E 503.7.2–Table E 503.7.3(2)

Joints and seams 603.9

Leakage test 603.9.2

Manifold (common duct) 511.4

Material of 506.1, 510.5.1, 602.0

Metal 506.1, 602.3, 603.3, 603.7.1

Non-grease type. 519.4, 519.5

Nonmetallic 602.4

Openings. 510.3, 510.3.3–510.3.3.2,
510.3.4.2, 511.1.5

Other grease 510.5, 602.4.4

Plastic 603.5

Product-conveying 218.0, 502.2.2,
506.0, Table 506.2(1),
Table 506.2(2)

Protection of. 506.9, 603.6

Solid-fuel 517.0

Support systems 504.4.5, 506.7–506.8.4,
510.1.6, 510.1.7, 510.3.3.3,
510.5.1, 603.3–603.3.1, 603.7

Termination 222.0, 502.2, 510.9,
519.5, 701.11

Underground. 510.8, 603.11

– E –

ECONOMIZERS 4076

ECONOMIZER, AIR E 503.5.1, E 503.5.1.2,
Table E 503.5.1.2

ECONOMIZER, WATER. E 503.5.2, E 503.5.2.1,
Table E 503.5.2

ELECTRIC HEATING APPLIANCES

Air conditioners 903.1

Duct heaters 905.8

Room heaters 916.1

ELECTRICAL CODE

Definition 207.0

ENCLOSED PARKING GARAGES. 403.72

ENCLOSURE OF DUCTS,

COMMERCIAL KITCHEN EXHAUST

Clearances 507.4.6.3, 507.4.8, 510.7.3

INDEX

FLAMMABLE VAPORS

Definition 208.0
Installation 902.9

FLOOD RESISTANT CONSTRUCTION

Coastal high hazard area 205.0, 305.3.1
Design flood elevation 206.0
Flood hazard area 208.0
Flood hazard resistance 305.3

FLOOR FURNACE(see Furnaces, floor furnace)

FUEL

Appliance(see Appliances)
Appliance, connectors, definition 203.0
Shutoff 513.4, 513.8, C 102.0,
Table 1003.2.1
Solid-fuel cooking 221.0, 508.6, 510.10,
511.1, 511.5, 513.12, 517.0
Temporary connection 105.4

FUEL APPLIANCE CONNECTOR

Definition 203.0

FUEL GAS

Definition 208.0

FUEL GAS MIXING

BLOWERS AND MACHINES 1310.14.3,
1310.14.4, 1310.14.5

FUEL GAS PIPING

Cathodic protection D 105.0
Change in direction 1310.8.3
Concealed location 1310.3
Detection of leaks 1313.4
Electrical bonding and grounding. 1311.0
Inspection and testing 1303.0, 1313.0
Installation 1310.0
Interconnections 1308.3
Joints and fittings 1308.5.4–1308.5.8,
1313.2.1, 1313.2.2
Materials 1308.5, D 109.0
Obstruction of flow. 1310.12
Purging 1313.6
Sizing 1308.4, 1314.0, 1315.0, D 108.0,
Table 1315.2(1)–Table 1315.2(36)
Supports. 1310.3.5, Table 1310.3.5.1
Underground
installations 1308.5.2.3, 1308.5.3.4, 1310.0,
D 101.2, D 109.3, D 110.3
Venting 1308.7.4

FUEL GAS TUBING

Cathodic protection D 105.0
Change in direction 1310.8.3
Concealed location 1310.4
Detection of leaks 1313.4
Electrical bonding and grounding. 1311.0
Inspection and testing 1303.0, 1313.0
Installation 1310.0
Interconnections 1308.3
Joints and fittings 1308.5.4–1308.5.8,
1313.2.1, 1313.2.2

Materials. 1308.5, D 109.0
Obstruction of flow. 1310.12
Purging 1313.6
Sizing 1308.4, 1314.1, 1315.0, D 108.0,
Table 1315.2(1)–Table 1315.2(36)
Supports. 1310.3.5, Table 1310.3.5.1
Underground installations 1308.5.2.3,
1308.5.3.4, 1310.1,
D 101.2, D 109.3, D 110.3
Venting 1308.7.4

FURNACES

Approximate gas input Table 1308.4.1
Automatic control required 608.6
Central heating furnaces 303.2, 904.0
Clearance for servicing 304.4.3,
905.8.2, 906.11
Clearances 303.10, 303.10.1, 904.2,
904.3.1.2, 905.1, 906.7,
Table 303.10.1, Table 904.2.2
Downflow-type,
heating, definition 208.0
Duct furnace 206.0, 905.0
Enclosed furnace, definition 208.0
Floor furnace 208.0, 906.0
Forced-air heating, definition 208.0
Furnace plenums 802.3.5, 903.2.3, 904.7
Gravity-type, floor
furnace, definition 209.0
Horizontal-type furnace 208.0, 904.9
Oil-fired central furnace. 904.11
Seepage pan, floor furnace 906.9
Solid fuel furnace 904.10
Upflow-type, heating 208.0, 904.9
Wall furnace, vented. 224.0, 907.0, Table 802.4
Warm air 225.0, 608.6, 608.7, C 105.1

FUSIBLE LINK

Definition 208.0

FUSIBLE PLUG

Definition 208.0

– G –

GALVANIZED STEEL

Definition 209.0

GAS CONVENIENCE OUTLET 1312.8

GAS ENGINE, STATIONARY 1602.0

GAS ENGINES,

AIR CONDITIONERS 903.2.2

GAS VENT CONNECTOR (see Connectors,
gas vent)

GAS VENT,

SURROUNDING SPACE 802.5.11

GAS-FIRED

Air conditioners
and heat pumps 903.2
Clothes dryers. 908.2
Household cooking appliances 920.2

– J –

JOINTS AND CONNECTIONS 1109.2,
 1109.8, 1211.0,
 1308.5.8–1308.5.9.6
 Brazed joint 212.0, 1211.3
 Copper or copper
 alloy pipe or tubing 1109.2, 1211.3, 1211.14.1
 CPVC piping 1211.2
 Embedded piping and joints 1221.2
 Expansion joint 1313.2.2
 Flared 212.0, 1211.3,
 1308.5.7.4, 1308.5.7.5
 Mechanical joint 212.0, 1109.7, 1211.5,
 1211.6, 1211.8, 1211.9,
 1211.12, 1211.13,
 1308.5.8.3
 PE pipe or tubing 1211.8
 PE-AL-PE pipe or tubing 1211.9
 PE-RT piping or tubing 1211.10
 PEX pipe or tubing 1211.5
 PEX-AL-PEX pipe or tubing 1211.6
 Plastic piping, joints, and fittings 1211.14.2
 PP piping or tubing 1211.11
 Press-Connect, definition 212.0
 PVC piping 1211.12
 Soldered joint 212.0
 Solvent cement
 plastic pipe 1211.2, 1211.12
 Steel pipe or tubing 1109.2, 1211.13
 Threaded joint 1211.2, 1211.13
 Various materials 1211.14
 Welded joint 212.0, 1211.13
JUMPER, BONDING
 Definition 204.0
 Fuel gas piping 1311.2

– K –

KILNS, SMALL CERAMICS 931.0
KITCHEN HOODS, COMMERCIAL 508.0

– L –

LABELED
 Definition 214.0
LABELS AND INSTRUCTIONS
 For appliances 307.0
 For heating appliances 307.0
 For hydronic systems 1204.0
 For refrigerating systems 1115.0
 For type I hoods 508.5.3
LABORATORIES 410.0
LADDER, PERMANENT 304.3.1.2
LEAKS
 Fuel gas 1313.4, 1313.5
LOWER FLAMMABILITY LIMIT (LFL)
 Definition 214.0

Product conveying ducts 505.1, 505.3
 Refrigeration 1104.4 **||**
LINE CONTACT INSTALLATION
 Definition 214.0
LIQUEFIED PETROLEUM GAS (LP-GAS)
Appliances 303.7.1
 Automatic control devices 306.0
 Definition 214.0
 Gas Facilities 214.0, 303.7, 1312.11
 Shutoff devices D 110.4
 Supply connections D 101.2, D 106.1
LISTED
 Definition 214.0
LISTED AND LISTING
Definition 214.0
LISTING AGENCY
 Definition 214.0
LOCATION OF
 Appliances in garages 305.1.1, 305.1.2, 905.7
 Appliances subject to
 mechanical damage 305.1.1
 Boilers, central heating 904.1
 Draft hoods and controls 802.12, 905.4
 Evaporative cooling systems 933.2
 Pool heaters 927.1
 Refrigerating equipment 1106.1
 Wall furnaces 907.2
LOUVERS 315.0
**LOUVERS, GRILLES,
 AND SCREENS** 701.10
**LOW-PRESSURE
 HOT-WATER-HEATING BOILER**
 Definition 214.0
LOW-PRESSURE STEAM-HEATING BOILER
 Definition 214.0
LOW-WATER CUTOFF 1008.0

– M –

MACHINERY
 Definition 215.0
MACHINERY ROOM, REFRIGERATION
 Equipment and controls in 1108.0
 Detectors and alarms 1106.2.5 **||**
 Ventilation of 1106.2.7, 1106.2.8 **||**
 Where required 1106.0, 1106.11 **||**
MAKEUP AIR (see Air, Makeup)
MARKING 302.1.1
MASONRY, CHIMNEYS (see Chimney, masonry)
MATERIALS
 Alternate 302.2
 For construction of
 hoods 508.3
 For piping, containers, and valves of
 refrigeration systems 1109.1
 For ducts 506.1, 510.5.1, 602.0
 For fuel piping 1308.0, D 109.0

INDEX

For piping, tubing and fittings hydraulics 1210.0, Table 1210.1
For vent connectors 802.10.1.1–802.10.1.4

MECHANICAL

Combustion air supply 701.9, E 502.6
Exhaust system 505.1
II Ventilating system 402.3, 1106.7, E 502.6, E 605.1.2, Table E 502.6

MECHANICAL EXHAUSTING FOR

Bathrooms E 605.2
Low-rise residential dwelling E 605.1.3
Product conveying 505.0
Refrigeration 1105.5.2, 1106.0

MECHANICAL JOINTS (see Joints and connections)

MECHANICAL PERMIT FEE 104.5, Table 104.5

MECHANICAL SYSTEMS

Application to existing 102.2
In elevator shaft 305.4

METAL

Chimneys 802.5.2
Ducts 506.1, 602.3, 603.3

METER, GAS 1308.6, D 104.0

METHODS OF CONSTRUCTION,

ALTERNATES 302.2

MINIMUM REQUIREMENTS

Purpose of Code 101.3

MINIMUM STANDARDS 302.1

MOBILE HOME PARKS

FUEL GAS EQUIPMENT AND INSTALLATION D 101.1

MOTORS, FANS, AND FILTERS 503.0

MULTIPLE-ZONE SYSTEM 404.0

– N –

NATURAL VENTILATION

Definition 216.0
Floor area to be ventilated 402.2.1
Indoor air quality for
low-rise residential buildings E 605.1
Indoor air quality for
residential occupancies 405.1.1
Location and size openings 402.2.2
Refrigeration systems 1106.3
Systems 402.2, 402.2.1

NEONATAL INTENSIVE CARE UNITS

Formula preparation area 419.1
Treatment Area/Room 419.2

NONCOMBUSTIBLE MATERIAL

Definition 216.0

NON-GREASE DUCTS 519.4

NUISANCE

Definition 216.0

– O –

OCCUPATION CLASSIFICATION

Definition 217.0

ODOROUS ROOMS 413.0

OIL BURNING BOILERS (see Boiler types, oil burning)

OPEN TOP BROILER UNIT 922.0

OPENINGS

Air heaters 914.7
Attics E 502.11
Ducts 506.6, 510.1.4, 510.3
Exhaust and intake 305.3.2, 926.3
For access 506.3, 510.1.4, 514.1.2, 1406.2.1.4
For combustion air 701.6, C 109.1
Furnaces 906.8
Illuminating appliances 924.4
Ratproofing 316.10
Relief 914.7
Screens 402.4, 802.1.2
Ventilation 402.2.1, 402.2.1.1, 402.2.1.2, 402.2.1.3, 402.2.1.4, 402.2.2, 402.2.3, 802.1.2, 802.10.3, 1105.5.1, 1106.3, E 605.1.1

OUTDOOR AIR INTAKES 407.2

OUTDOOR AIR RATE

Calculation Appendix H

OUTLETS

Appliance flue 203.0, 802.10.5, 803.1.1
Draft hood 802.10.2.1, 802.10.5, 803.1.1
Exhaust 508.7
Fuel gas piping 1305.2, 1306.3, 1310.10, 1312.8, 1314.4

OVER PRESSURE PROTECTION

Fuel gas piping 1308.7.1, 1310.6.1

OVERHEAD HEATERS

In garages 926.4

– P –

PENALTIES 106.2, 106.3

PERMISSIBLE EXPOSURE

LIMIT (PEL)

Definition 218.0

PERMITS

Application 103.3, 104.3, 302.3.1, 1402.0
Construction documents 104.3.1
Exempt 104.2
Expiration 104.4.3
Fees 104.5, Table 104.5
For alteration 104.1
Inspection 105.0
Investigation fees 104.5.2
Issuance 104.4
Mechanical systems 104.0
Retention of plans 104.4.6

Suspension or revocation of 104.4.5
 To operate boiler or
 pressure vessel 1013.2
 Validity 104.4.2
 Work without 104.5.1
PERMITS AND INSPECTIONS 104.0, 105.0,
 302.3.1, 302.3.6
PHARMACIES 505.12
PHARMACEUTICAL COMPOUND EXHAUST
 DISCHARGE 5077
PILOT
 Boilers. 1006.1, 1007.1, C 106.0, C 107.0
 Continuous, definition 205.0
 Definition 218.0
 Intermittent, definition. 211.0
 Interrupted, definition 211.0
PIPING
 Fuel gas 1308.0, 1310.0
 Hangers and supports 313.0, 1105.2,
 1109.6, 1210.3,
 1310.3.5, 1310.3.5.1,
 Table 313.3, Table 1310.3.5.1
 Hydronics 1210.0, Table 1210.1
 Identification 1109.10, 1204.0
 Joints and connections. (see Joints
 and connections)
 Protection of 316.0, 1109.4.1,
 1310.1.3, 1310.1.4
 Trenching, excavation,
 and backfill 317.0
 Underground 1109.5, 1109.5.1, 1310.1.6
PIPING TYPES
 Double-wall Table 803.1.2(1),
 Table 803.1.2(2),
 Table 803.2(1), Table 803.2(2)
 Single-wall metal 802.7, Table 803.1.2(5)
PLANS
 Approval by Authority
 Having Jurisdiction 104.3
 Retention of 104.4.6
 Review fees 104.3.2
PLENUMS
 Applicability 601.1
 Closure systems 603.9
 Combustibles within 602.2
 Definition 218.0
 Furnace 603.13.4, 604.1, 802.3.5,
 903.2.3, 904.2
 Heating and cooling system 605.1, E 503.3.1
 Hood 516.6.3
 Insulation E 503.4.7.1.1
 Leakage E 503.4.7.2.1
 Material 602.1
 Metal 602.3
 Serving type II hoods 510.1.7

Supply-air. 508.3.5, 508.3.5.3,
 508.3.5.3.3, 608.0,
 E 503.4.7.1.1
 Use of under-floor as supply plenum. 608.0
 Where dampers are required 701.12
PLUMBING CODE
 Definition 218.0
POLYETHYLENE (PE) PIPE OR TUBING
 Definition 218.0
 Fuel gas 1308.5.4,
 Table 1315.2(19)–Table 1315.2(23),
 Table 1315.2(34)–Table 1315.2(36)
 Hydronics 1210.0, Table 1210.1
 Joining
 and connections (see Joints
 and connections)
POLYETHYLENE-ALUMINUM-POLYETHYLENE
(PE-AL-PE) PIPE OR TUBING
 Definition 218.0
 Ground source loop. Table F 104.2, Table F 104.3
 Hydronics 1210.0, Table 1210.1
 Joining and connections. (see Joints
 and connections)
POLYETHYLENE OF RAISED
TEMPERATURE (PE-RT) PIPE OR TUBING
 Definition 218.0
 Ground source loop. Table F 104.2,
 Table F 104.3
 Hydronics 1210.0, Table 1210.1,
 Table 1220.4.1
 Joining and connections. (see Joints
 and connections)
 Oxygen diffusion 1210.4
POLYPROPYLENE (PP) PIPE OR TUBING
 Definition 218.0
 Ground source loop. Table F 104.2,
 Table F 104.3
 Hydronics 1210.0, Table 1210.1
 Joining and connections. (see Joints
 and connections)
POLYVINYL CHLORIDE (PVC) PIPE OR TUBING
 Definition 218.0
 Ground source loop. Table F 104.2, Table F 104.3
 Hydronics 1210.0, Table 1210.1
PORTABLE
 Cooling unit 104.2, 218.0
 Evaporative cooler 104.2, 218.0
 Fire extinguishers 513.2, 513.11
 Heating appliance 104.2, 218.0
 Ventilating equipment. 104.2, 218.0
POSITIVE DISPLACEMENT COMPRESSOR
 Refrigeration 1112.2
POWER BOILER PLANT
 Definition 218.0

INDEX

PRESSURE

Design, definition 218.0
 Field test, definition 218.0
 Imposing element, definition 218.0
 Limiting devices. 218.0, 904.4,
 927.3, 1111.0, 1308.10.6
 Relief devices 218.0, 904.6, 1112.0,
 1113.0, 1115.4, C 109.1
 Tanks D 113.6.2
 Test, definition 218.0
 Vessel 218.0, Chapter 10,
 1113.0, 1117.0
 Vessel, refrigerant 218.0, 1113.0, 1117.0

PRESSURE-RELIEF VALVE

Definition 224.0
 Discharge 1005.2, 1112.10, 1112.11, 1206.2
 Hydronics 1206.0, F 106.8
 Pressure vessels 1005.0, 1113.0,
 Refrigeration system. 1111.2, 1112.0, 1113.0, 1115.4
 Steam and hot
 water boilers (low pressure) 904.6

PROTECTION

Fire 506.8, 507.4.3.1, 510.3.7,
 512.3.3, 513.2.1, 516.2.3,
 516.5, 1108.1, 1406.2.1.4
 Overpressure 1308.8, 1310.6.1
 Personnel 301.6
 Piping, materials, and structures 316.0

PURGE

Definition 218.0
 Fuel gas 1313.6

PROTECTIVE ENVIRONMENT ROOMS 415.0

– R –

RADIANT HEATING AND COOLING 1217.0

RADIANT ROOM HEATER

Definition 220.0

RANGE

Commercial 921.1
 Domestic 504.3, 920.0
 Oil burning 921.3
 Ventilation of 504.3

RATPROOFING 316.10

RECIRCULATING SYSTEMS

Definition 220.0
 Exhaust 516.0
 Labeling 516.2.4, 516.2.5
 Listing 516.2.2, 516.2.5, 516.2.9
 Ventilation 403.5

REFRIGERANTS

|| Ammonia 102.1, 1104.4, 1104.5,
 1106.0, 1106.1.4, 1106.5, 1114.1,
 Table 1102.3, Table E 503.7.1(7)
 Amount of 1104.2
 || Applications for human comfort 1104.7
 Azeotrope, definition 203.0
 Changing of 1104.9

Classification of 1103.0 ||
 Concentration limit 220.0, 1104.2, 1104.6.1
 Containers 1109.0 ||
 Emergency purge 1106.0
 Flammable 1104.5, 1104.6.3 ||
 Group A2L Refrigerants for Human Comfort 1104.6 ||
 In institutional occupancies 1104.3
 In nonindustrial occupancies 1104.7 ||
 Listing and Installation Requirements 1104.6.2 ||
 Parts in ducts. 1106.8 ||
 Piping 1109.0
 Port protection 1105.11
 Pressure vessel 218.0, 1104.6.5, 1113.0, 1117.0 ||
 Purity 1104.8 ||
 Mechanical Ventilation 1104.6.4 ||
 Mixing of 1104.8.4 ||
 Reclaimed 220.0, 1104.8.3 ||
 Recovered 220.0, 1104.8.1 ||
 Recovery 1101.2
 Recycled 220.0, 1104.8.2 ||
 Refrigerant, definition 220.0 ||
 Refrigerant designation, definition 220.0
 Refrigerant Sensors 1104.6.6 ||
 Requirements for 1104.0
 Safety classification, definition 220.0, Table 1103.1.1 ||
 Storage of 1105.12
 Types used 1102.3, 1104.8, Table 1102.3 ||
 Zeotropic, definition. 228.0

REFRIGERATION EQUIPMENT

Access 1105.3
 Coils. 310.6, 903.2.5, 904.7, 905.6
 Controls 1108.0
 Identification. 1115.0
 Illumination and
 service receptacles 1105.4
 Location of 1104.2, 1105.0
 Refrigeration recovery 1101.2
 Supports and anchorage 1105.2
 Testing of 1116.0, Table 1116.2
 Valves. (see Valves, for refrigeration systems)

REFRIGERATION

**MACHINERY ROOMS 220.0, 1106.0, 1106.11, ||
 1107.0, 1115.3 ||**

REFRIGERATION SPACES

Concentration limit. 1102.3, 1104.2, Table 1102.3
 Industrial occupancies 1104.4
 Institutional occupancies 1104.3
 Nonconnecting spaces 1104.2.2
 Refrigerated spaces 1104.4
 Ventilated spaces 1104.2.3
 Volume calculation 1104.2.1

REFRIGERATION SYSTEM CLASSIFICATION

Definition. 220.0
 High-probability systems. 1103.2.1
 Higher flammability refrigerants. 1103.3
 Low-probability 1103.2.2

REFRIGERATION SYSTEMS

- Absorption 220.0, 307.4
- Appliances 934.0
- Attic 1105.3, 1105.9
- Classification of 1103.2
- Condensation 310.6, 1105.7, 1105.10, 1109.9
- Containing
 - hazardous fluids 1125.0
- Defrost 1105.8, 1105.10
- Discharge piping 1112.10, 1112.11, 1114.1
- Duct furnaces used with 905.6
- Electrical 1108.2
- Emergency shut-off 1108.3
- Flaring device 1114.1–1114.3
- High probability 1103.2.1
- Highside, definition 210.0
- Human comfort 1105.1
- Labeling 307.3, 307.4, 1115.3
- Low probability 1103.2.2
- Lowside, definition 214.0
- Machinery room 220.0, 1106.0,
 - 1106.11, 1107.0, 1115.3
- Maintenance and operation 1118.0
- Mechanical 220.0, 934.3
- Mechanical system, definition 220.0
- Mechanical ventilation 1106.11, 1107.0
- Permissible Table 1104.1
- Pressure-limiting devices 1111.0
- Pressure-relief devices 1112.0, 1112.9,
 - 1112.10, 1112.11,
 - 1113.4, 1113.5,
 - 1115.4, Table 1113.5
- Probability 1103.2, 1103.2.1, 1103.2.2
- Protection from
 - mechanical damage 1109.4.1
- Requirements for 1104.0
- Self-contained mechanical
 - refrigeration systems 934.3
- Self-contained refrigerators
 - and freezers 934.1
- Unit coolers 934.2
- Ventilation of room 1105.5, 1106.11, 1107.0

REFRIGERATORS

- Clearance 926.2
- Factory-built 934.1
- Ventilating kit 928.2

REGULATOR VENT PIPING 1308.5.4.1

REGULATORS

- Combustion 1009.0
- Gas appliance 924.5
- Gas-pressure regulators 1007.0
- Vent piping 1308.5.4.1

RISER HEAT PIPE

- Definition 220.0

ROOFTOP TERMINATIONS

- Chimneys 802.5.4, 802.7.2,
 - 803.1.10, 803.2.20

- Fans 511.1.3.1
- Gas vents 802.6.1, 802.7.2,
 - 803.1.10, 803.2.20

ROOM HEATERS 220.0, 916.0

ROOM

- Bathroom and laundry 504.6
- Boiler 204.0, 303.2, 1001.2, 1001.4
- Equipment 303.2, 305.1.3
- HPM storage 210.0
- Machinery 1106.0, 1106.11,
 - 1107.0, 1108.0, 1115.3
- Used for ventilation 402.2.2

RUPTURE MEMBERS 220.0, 1112.10.1,

- 1112.13, 1113.3, 1115.4.1

– S –

SEDIMENT TRAPS 1310.9.2, 1312.9

SEEPAGE PAN 906.9

SELF-CONTAINED 221.0, 517.1.2

SHAFT

- Definition 221.0
- Fuel gas piping 1310.3.4
- Refrigeration systems 305.4, 1109.4.1
- Ventilation system E 503.4.6.4

SHAFT ENCLOSURE

- Definition 221.0

SHUTOFF

- Automatic 609.0
- Fuel 513.4, 513.8, C 102.0,
 - Table 1003.2.1

SMOKE DAMPERS 206.0, 606.0

SMOKE DETECTORS 221.0, 609.0

SNOWMELT SYSTEMS 1220.4, 1220.4.1,

- 1217.5.2, Table 1220.4.1

SOLAR ENERGY SYSTEMS 1502.0.

SOLID-FUEL

- Boilers 1002.4
- Burning appliances 902.10
- Chimney, combination
 - gas- and solid-fuel 802.5.8.2
- Cooking operations 517.0
- Furnace 904.10
- Room heaters 916.3
- Venting 801.3

SPARK ARRESTERS

- Definition 221.0
- Solid-fuel cooking operations 517.1.6

SPECIFIC APPLIANCES,
INSTALLATION OF Chapter 9

STANDARDS

- Definition 221.0
- General 301.2, 302.1.2
- Fire-extinguishing systems 513.2.2
- Fuel gas piping D 115.1

INDEX

Hydronics 1203.2, 1207.3, Table 1210.1
Oil-or liquid-fuel
burning equipment. C 103.0
Referenced. Chapter 17
Steam and hot water boilers 1002.0

STATIONARY

Engine generators. 1602.0
Fuel Cell Power Plant 221.0, 1601.0
Gas Engines 1602.0

STEAM AND HOT-WATER SYSTEMS 319.0

SUPPORT AND HANGERS 313.0, Table 313.3

SUSTAINABLE PRACTICES Appendix E

SWITCHES, ELECTRICAL SUPPLY LINE 903.2.6

- T -

TANKLESS WATER HEATERS 1203.3

TERMINATION

Chimneys 802.5.4, 802.5.4.2
Environmental air ducts 502.2.1
Exhaust duct systems,
commercial kitchen 510.9, 519.5
Exhaust
ducts, clothes dryer 504.4
Gas vents 802.6, 802.6.1,
802.7.2, 802.8, 802.8.2
Product conveying ducts 502.2.2
Type I hood exhaust system 510.9
Type II hood exhaust system 519.5

TESTING

Of boilers 1012.1, 1013.0
Of ducts 602.2
Of exhaust systems 514.0
Of fuel-gas piping 105.3, 1313.0
Of hood assemblies 508.2
Of insulating materials 508.3.4, 602.2
Of louvers 315.1.1, 315.1.2
Of recirculating systems 516.2.2, 516.2.5,
516.6.4
Of refrigerating equipment 105.3, 1114.3,
1116.0
Of safety interlocks 516.6.4
Required by the Authority
Having Jurisdiction 302.2.1

TESTING AGENCY

Definition 222.0

TESTING AND BALANCING 417.0

THERMAL RECOVERY UNIT

Definition 222.0

TOILETS, GAS FIRED 929.0, Table 802.4

TYPES OF

Chimneys (see Chimney)

- U -

UMC

Definition 223.0

UNCONSTITUTIONAL 101.4

UNDER-FLOOR SPACE 304.4, 608.0

UNIT HEATER 223.0, 917.0, Table E 503.7.1(5)

UNSAFE EQUIPMENT 102.5

UNUSUALLY TIGHT CONSTRUCTION

Definition 223.0

- V -

VALIDITY OF PERMITS 104.4.2

VALVE TYPES

Bleed lines for diaphragm-type 902.16
Companion or block, definition 224.0
Pressure relief 224.0, 904.6,
927.3, 1112.0,
1113.0, 1115.4, C 109.1
Safety or relief 1005.0, 1009.0, C 109.1
Shutoff 904.6, 1006.0, 1308.13, 1310.10.1.1,
1310.11, 1312.3.1, 1312.3.2,
1312.5.3, 1312.6, 1406.2.1.5,
C 109.1, D 103.0, D 104.3,
D 110.4, D 112.3
Stop 224.0, 1112.6

VALVES

For fuel gas piping 1308.5.1, 1308.5.7.5,
1308.11.1, 1308.13, 1309.1,
1310.3.3.1, 1310.10.1.1,
1310.11, 1310.14.6,
1312.3.1, 1312.3.2,
1312.5.3, 1312.6, 1312.9,
1313.1.4, 1313.1.5,
D 103.0, D 104.3, D 110.4,
D 112.3, D 113.3
For hydronics 1212.0
For mobile home parks D 103.0, D 104.3, D 110.4,
D 112.3, D 113.3
For recreational vehicle park D 103.0, D 104.3,
D 110.4, D 112.3, D 113.3
For refrigeration systems 1105.3, 1109.0,
1110.0, 1112.6,
1112.9, 1113.6

VENT

Appliances not requiring vents 802.2.1
Caps 802.7.4(3)
Clearance 802.7.3.4, Table 303.10.1,
Table 802.7.3.3
Dampers 802.13, 802.15, 802.15.1
Direct vent 802.2.6
General requirements 802.0
Insulation shield 802.6.1.1
Integral 802.2.7
Listing 802.1
Mechanical draft 802.3.3-802.3.3.5
Obstruction of flow 802.14
Plastic piping 802.4.1
Special 802.4.3
Termination 802.6.1, 802.7.2,
802.8
Wall penetration 802.8

VENT, ATTIC 802.10.1.1, 802.10.1.2

VENT, GAS 224.0, 802.4, 802.6, 802.6.2, 802.6.2.1, 802.6.2.2

VENT, GAS CONNECTORS (see Connectors, gas vent)

VENT DAMPERS (see Dampers)

VENT SIZING

Category I appliances 802.6.2.1, 803.0

Multiple appliances 803.2, Table 803.2(1)–Table 803.2(9)

Multistory 802.6.3, 802.6.3.2, 803.2.16

Single appliance 802.7.4(1)(b), 802.10.2.1, 803.1, Table 803.1.2(1)–Table 803.1.2(6)

VENTED

Decorative appliances 224.0, 911.0, Table 802.4, Table 911.2

Equipment not required to be 802.2.1

Fireplaces 912.0, E 602.0, Table 911.2, Table 1308.4.1

Wall furnace 224.0, 907.1, Table 802.4

VENTED APPLIANCE CATEGORIES

Category I 224.0, 701.1.1, 802.6.2.1, 802.6.3, 802.9.1, 802.10, 802.10.1.1, 802.10.3.2, 803.0, Appendix G, Table 802.4, Table 803.1.2(1)–Table 803.1.2(4), Table 803.2(1)–Table 803.2(4)

Category II 224.0, 802.6.2.3, 802.9, 802.11, Table 802.4

Category III 224.0, 802.6.2.3, 802.9.1, Table 802.4

Category IV 224.0, 802.6.2.3, 802.9, 802.11, Table 802.4

VENTILATED SPACES 802.2.5

VENTILATING

Ceiling 224.0, 607.0

Equipment 513.4.2, 514.1.2

Hoods 802.2.4, 802.3.4, 920.4.2, 922.3

Kits for use in refrigerators 928.2

Portable, equipment, definition 218.0

VENTILATION

Air class and recirculation 403.9

Mechanical 402.3, 405.0

Multiple zone systems 404.0

Natural 402.2, 402.2.1, 405.1.1, E 605.1.1

Obstructions of 802.14

Parking garages 403.7.1, 403.7.2

Rates 403.0, Table 402.1

VENTILATORS, HEAT (ENERGY) RECOVERY 210.0, 504.5

VENTING COLLAR

Definition 224.0

VENTING SELECTION TABLES

Exterior masonry chimney Table 803.1.2(6), Table 803.2(6), Table 803.2(7), Table 803.2(8), Table 803.2(9)

Masonry Chimneys Table 803.1.2(3), Table 803.1.2(4), Table 803.2(3), Table 803.2(4)

Single appliances Table 803.1.2(1)–Table 803.1.2(6)

Single-wall metal pipe or type B asbestos cement vent Table 803.1.2(5), Table 803.2(5)

Two or more appliances Table 803.2(1)–Table 803.2(9)

Type B double-wall gas vent Table 803.1.2(1), Table 803.1.2(2), Table 803.2(1), Table 803.2(2)

VIBRATION ISOLATORS 602.5, 1001.5

VOLUME DAMPERS

Definition 206.0

– W –

WALL

Furnace 907.0

Furnace, vented, definition 224.0

Heater, definition 225.0

Terminations 510.9.2

WARM AIR FURNACE

Definition 225.0

Heating systems 311.0

Located in under-floor spaces 608.0

WATER HEATERS

Accepted standards 1203.2, 1207.3, Table 1203.2

Drain pans 305.5

Dual purpose 1203.2, 1207.3, Table 1203.2

For space heating and cooling 1203.2, Table 1203.2

Tankless 1203.3

WELD, CONTINUOUS

Definition 205.0

Joints 212.0, 1211.13

Pressure Vessels 1003.5

Welded duct connections 510.5.3.2

WORKMANSHIP 309.0

– Z –

ZONE 228.0

HISTORY NOTE APPENDIX
2022 CALIFORNIA MECHANICAL CODE
CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 4

HISTORY:

For prior code history, see the History Note Appendix to the California Mechanical Code, 2019 Triennial Edition, effective January 1, 2020.

1. *(BSC 01/21, CEC 03/21, DSA-SS 01/21, HCD 01/21, OSHPD 01/21, SFM 01/21) Adoption by reference the 2021 Uniform Mechanical Code with necessary amendments to become the 2022 California Mechanical Code, and repeal of the 2018 edition of the Uniform Mechanical Code; effective on January 1, 2023.*
2. *2022 Intervening Cycle Update (OSHPD 05/22, SFM 05/22) Adoption of amendments to the 2022 California Mechanical Code. Effective on July 1, 2024.*

